INSIDE: DISAPPOINTMENT AT SWAN LAKE
Montana Outdoors
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MAY–JUNE 2016
STOP OR GO?
The challenge of restoring fish connectivity in Montana
IN THIS ISSUE:
A NEW FWP VISION
HOW HATCHERIES HELP NATIVES
A NEW DAY ON THE MUSSELSHELL
NO FINESSE NEEDED FOR BIG BROWNS

Montana Fish, Wildlife & Parks

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Montana Outdoors

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CENTRAL MONTANA LIFELINE
As it winds through central Montana, the Musselshell River provides essential water for agriculture and native fish. See our story on page 10. Photo by Chris Boyer.

FRONT COVER
Rainbow trout spawn in a tributary of the Missouri River below Toston Dam. Learn why trout and other species need to travel for spawning and other life history requirements on page 34. Photo by Kenton Rowe.

Honk to prevent roadkill

Regarding your article "From Freeway to Freezer" (March-April): One thing that has worked for me over the years to prevent collisions is to use my horn. The sound of my horn has saved me from dozens of accidents with elk and deer.

Tom Peets
Salmon, ID

Shoulder season needs hunt rosters

Regarding your article "Shouldering Its Responsibility" (November-December): The shoulder season circumvents state law requiring landowners to allow access to their land if they want assistance with big game damage. Hunters want to help ranchers, but because the shoulder season doesn't have a hunt roster, they don't have fair opportunity to gain access to many properties. I wonder if the shoulder seasons will reduce populations much, but I'm pretty sure access will now be dominated by "friends and family," just like the regular season. I hope FWP can find a way for hunters to be selected for the shoulder season using a fair permit system.

Rob Gregoire
Bozeman

That land is our land

"Cow or Plow" in the March-April issue is a great article with great photos. I fully concur with the article except the line on page 39: "The BLM, which owns millions of acres...." The Bureau of Land Management, U.S. Forest Service, National Park Service, and other federal agencies don't "own" any property. They don't even "own" their offices or vehicles. The land belongs to "we, the people" of the United States. Those agencies are tasked with managing our properties, not owning them. The people pushing to "return" federal lands to the states fail to realize that the lands already belong to everyone in the United States.

PJ Smith
Kalispell

Don't fence us in

Freedom to roam has been a fundamental right for Montanans since before statehood, lasting until recent times. Ask anyone middle-aged or older about growing up here, and most will reminisce about rambling the countryside, hiking, fishing, exploring, and crossing fences regardless of property boundaries. Unfortunately, many newcomers to the state, unaware of Montana traditions,

> **"Freedom to roam goes hand-in-hand with nurturing a sense of respect for the land and landowner."**

posted "No Trespassing" signs to keep people out. Acre by acre, property by property, we lost access, and, with it, part of our identity. Montanans have always cherished a deep connection to nature. Yet, without the right to roam, children grow up on roads and lawns and using electronics. That isn't the Montana way.

Freedom to roam goes hand in hand with nurturing a sense of respect for the land and landowners. Those who remember this freedom likely did not leave gates open, cut fences, litter, or vandalize properties. Those are symptoms of bored and disconnected citizens, lacking an ethic of stewardship. Montanans should restore the right to roam and, with it, cultivate a renewed sense of stewardship and respect for the land and landowners.

Thomas J. Elpel
Pony

Fellow travelers

Last summer my wife and I experienced deer mice in our garage that had hitchhiked on our truck or boat trailer almost every time they were parked at surrounding lakes or trailheads, even if just for a couple of hours. Apparently the joy riders were hopping on for free transport, something we have never seen in our three decades living in Montana. The morning after an outing, little droppings would appear all over the garage floor, inside tall recycling bins, and atop shelves. We set snap traps with peanut butter where most of the droppings were located. Within hours the peanut butter would be licked clean, but often no intruders were trapped. We knew the mice were hitchhiking because, while backing into the garage after a camping trip, my wife saw one drop down off the truck and run for the lawn. Another time, while camping with friends, we saw a mouse come out onto the grill of their truck, look around, run across the bumper, jump over to the tire, and scamper away. After trapping more than 30 mice during the summer following lake or trail excursions, we had success parking outside for a night to allow the hitchhikers to leave. The reason for this note is to ask if readers, biologists, or other outdoor enthusiasts noticed an increase in mice numbers last summer.

Greg Kindschi
Bozeman

Kerry Foresman, emeritus professor of biology at the University of Montana and author of Mammals of Montana, *responds: I'm not aware of any exceptional increase in deer mice numbers last year. Deer mice do not exhibit large population cycles, though their numbers can increase from one year to the next depending upon environmental conditions. Their population is higher in the fall, as the young animals born during summer mature. I have had bushy-tailed woodrats and chipmunks hitch rides with me from as far away as the Beartooth Plateau to my home in Missoula, so what you and your wife experienced, while not common, is not rare. Keeping the vehicle in the driveway after excursions seems to be a smart move. Also, it might be worth giving your vehicle a thorough washing, inside and out. There may be something in there attracting the mice.*

Trout Meunière Amandine

By Tom Dickson | Preparation time: 20 minutes | Cooking time: 20 minutes | Serves 4

Like many anglers, I release most of the trout I catch, but sometimes I'll harvest one or two to make a meal. Consuming my catch is a way to deepen my outdoor experience, in the same way that eating deer, elk, pronghorn, waterfowl, and upland game birds enriches my hunting season.

One way to honor a harvested rainbow or brown is by preparing Trout Meunière Amandine. Served in high-end restaurants worldwide, this classic French dish is fancy but not difficult. And the results! Oo-la-la.

The French word *meunière* (man-YARE) refers both to the sauce—brown butter, chopped parsley, and lemon—and the method of cooking, which is to dredge a fish in flour and pan fry it. *Amandine* (AH-mahn-deen) means prepared with almonds.

Brown butter is butter cooked until it has melted into a liquid, the water has cooked off, and the remaining milk solids begin to toast and brown to a delicious and nutty flavor.

I toast the almonds in the microwave. It's much faster than using the stove and requires far less monitoring than stovetop toasting. Put sliced almonds on a plate, cook for one minute on high, stir, and cook for another minute.

Rice cooker revisited

In the March-April issue I recommended a cooker for making rice to accompany Venison Stir Fry. Several readers have pointed out that the cooker costs a whopping $139. I had no idea. When my wife and I bought ours, it was one-third that price. I did some research and found that *Cook's Illustrated* "highly recommends" the Aroma 8-Cup Digital Rice Cooker and Food Steamer. The price? Just $30.

—Tom Dickson is editor of Montana Outdoors.

INGREDIENTS

- 2 c. all-purpose flour
- 2 trout fillets, or 1 whole or 2 whole smaller trout (gutted)
- Vegetable oil
- 2 T. plus 6 T. butter
- Black pepper and kosher salt
- 3 sprigs fresh thyme, leaves stripped and chopped, or ½ t. dried thyme
- 2 T. fresh lemon juice
- ¼ c. finely chopped flat-leaf (Italian) parsley
- ½ c. sliced almonds, lightly toasted

DIRECTIONS

Preheat oven to 200 degrees F.

Place flour in a pie dish. Rinse fish and pat dry with paper towels. Generously coat a large sauté pan with vegetable oil and bring to a high heat. Once the oil is shimmering, add 2 T. butter. Quickly season the fillets or whole trout with salt and paper. Dredge in flour, shake off excess, and immediately place fish in the pan with the hot, shimmering oil and butter. If you're cooking whole trout, repeatedly spoon the heated oil-butter mixture into the cavity to speed interior cooking.

After three minutes for fillets (five to seven minutes for whole trout depending on size), flip and cook for the same amount of time. Transfer the fish to a baking rack set in the oven.

Brown butter

Pour drippings from pan and wipe clean with a paper towel. Turn heat to medium-high and add the remaining 6 T. butter along with the thyme. Stir frequently with a rubber spatula to prevent scorching. Once the butter starts to foam, watch it carefully. The butter is browning when the browned milk solids start to appear as dark golden flecks in the melted butter, which gives off a nutty, toasty aroma. Pour hot butter into a heat-proof container (like a Pyrex measuring cup) so it stops cooking. Add the lemon juice and whisk to combine. Season with salt and whisk in the chopped parsley. Remove fish from the oven, spoon sauce over fish, and sprinkle with toasted almonds. ■

Who We Are and Where We're Going

Montana Fish, Wildlife & Parks touches the lives of almost everyone who lives in or visits this state. Our work affects ranchers, hunters, anglers, farmers, outfitters, guides, state parks visitors, hotel and cafe owners, tourists, fly shop employees, students, and many others.

Because of our vast effect, we are obligated to do the best job we can. And to continually improve.

The department took a big step in that direction recently with completion of a new FWP vision that sets the direction for what this department wants to achieve in the next decade. It contains eight core values, nine commitments, and roughly two dozen actions for fulfilling our promises to the public and our employees.

Our core values, as detailed in the new vision document, are to serve the public, embrace the public trust, honor tradition and heritage, work with landowners, provide leadership, use science, provide stewardship, and value our workforce. These core values guide all of us in this department as we do business every day.

Our nine commitments are too lengthy to list here. But they include such promises as doing a better job of understanding and responding to public expectations, providing diverse opportunities and services, and remaining fiscally responsible and sustainable.

FWP's new vision was created by employees from all levels of the department statewide using input from ten public and eight employee "listening sessions" held last summer across Montana.

It's been nearly 20 years since FWP last developed a vision for the future. Most of us in the department—myself included—weren't around then. We didn't have the opportunity to join those discussions about what FWP is and where it is going. What's more, because much about Montana has changed over the past two decades, we need a new vision that addresses new challenges. For instance:

- Hunters and anglers increasingly request more and better information, access, and opportunity.
- Interest in nongame wildlife management and wildlife watching continues to grow.
- Fast-paced technologies such as social media and mobile, personalized communication platforms are creating new opportunities and challenges for the department.
- Visits to state parks have doubled in recent years, while revenue for management and maintenance has remained flat.
- Currently, more than half of FWP staff have worked for the department less than 10 years. Many may not be aware of this agency's core values and guiding principles.
- Traditional funding sources alone are no longer sufficient to meet our growing responsibilities and public demands.

Montana has long excelled in fish, wildlife, and state parks conservation and management. But we can't simply rest on past achievements. If FWP is to remain relevant in today's rapidly changing social, economic, and natural environments, we must chart a smart and effective course. We must build on the department's best traditions while embracing new public values, interests, and ways of doing business. FWP's new vision will do that by, among many things:

- increasing the public's understanding of the services FWP provides while identifying where we are not meeting public expectations and how we can improve;
- creating a more cohesive and effective conservation community throughout Montana;
- growing a stronger, broader, and more stable funding base for the work we do; and
- strengthening the department by improving internal communication and creating a unified sense of common purpose.

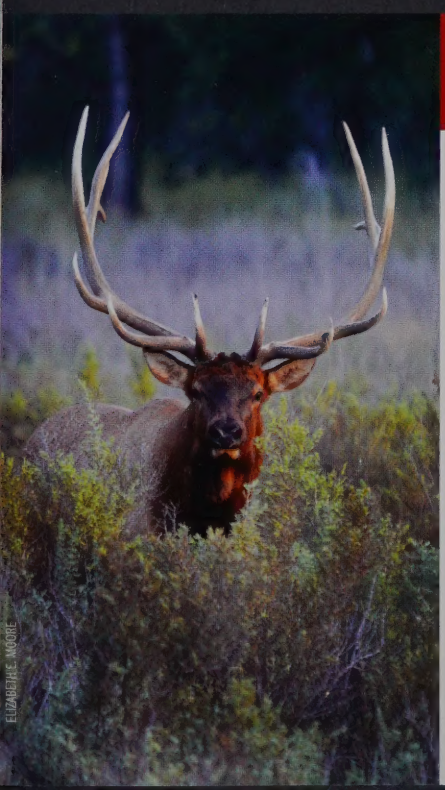
> "For any organization to remain relevant and effective, it must regularly examine where it is headed."

For any organization to remain relevant and effective, it must regularly examine why it exists, where it is headed, and whether it has been fully achieving its mission. That's what we've done with the new FWP vision. I'm confident that this new vision will help both our new and longtime employees continue to serve the public as they conserve and enhance the wildlife, fisheries, state parks, and outdoor recreation and heritage that define Montana's identity and character.

—**M. Jeff Hagener**, Montana Fish, Wildlife & Parks Director

The FWP Vision and Guide *document will be available at fwp.mt.gov later this summer.*

MATT LUPIN



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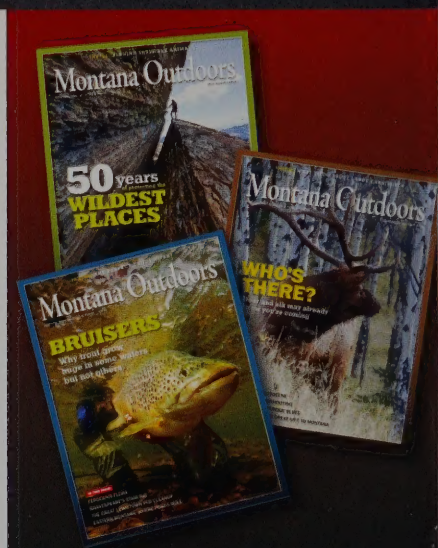

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NICOLE KEINTZ

LORD OF THE LOTTERIES

NEAL WHITNEY
Licensing Bureau Analyst, Helena

May and June are exciting months in the Licensing Bureau. The application deadline for moose, bighorn sheep, bison, and mountain goat licenses is May 1, and we get swamped processing those tens of thousands of applications. In early May we start gearing up for the June 1 deadline for elk B, deer B, antelope B, and regular antelope licenses. The biggest event is in mid-June, when we hold the lotteries for moose, sheep, bison, and goat licenses. As a hunter myself, I know that right now a lot of hunters are anxiously awaiting those results.

Our top priority is to ensure that the lotteries are fair and the computer system we use for drawings is accurate and impartial. The drawing process is regularly audited by the Legislative Auditor's office to make sure everything is working correctly and impartially. That review helps allay the public's concerns about bias, errors, or favoritism.

People sometimes ask me if I'm able to up the odds for my own applications. I wish. I've worked for FWP for 31 years and have never drawn a trophy ram license. I once drew a special permit for trophy mule deer bucks in hunting district 455—but that was after putting in for 17 years.

One June evening professional photographer **JOHN ASHLEY**, who lives west of Kalispell, headed to nearby Island Lake after reading that an aurora was forecast for that night. "As I set up my tripod in the shallows in the dark, I could hear the fluttering of wings off to my right," he says. "With my flashlight I could see there were 20 or so bats—probably little brown myotis—foraging low over the water. I started the time-lapse shoot, with the shutter open for 10 seconds at a time, to capture the aurora. In the darkness the bats were invisible to the camera, so whenever my flashlight showed bats in front of me, I'd fire a flash so the camera could detect the bats. Some of the bats were actually lit up enough by the flash to reflect off the water surface. During all this time, the camera was also picking up the aurora swaying in the background. Back at my studio, I layered several consecutive frames to produce a starry aurora image that also provides a glimpse of some of the wildlife activity that goes on after the sun goes down." ■

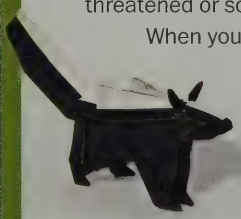
150

Estimated number of wild adult pallid sturgeon remaining in Montana waters (Missouri and Yellowstone Rivers).

Living with skunks

Phew! Smell that?

Many homeowners become alarmed when they catch a whiff of skunk near their home. Yet often there's no reason to worry. Skunks regularly make dens under sheds, decks, and houses and live there without ever spraying their human hosts. Skunks are generally shy, nonaggressive, retiring, and nocturnal. They spray only when threatened or scared.



When you smell a skunk near your house or garage, the animal likely had been startled by a noise at night and sprayed in self-defense.

With a little acceptance and understanding, you can live with skunks as long as you don't bother them. If you have pets or young children, however, that may not be possible.

To convince skunks to leave your premises, make sure you're not leaving dog food, cat food, or garbage where the wild animals can reach it. Board up entries and crawl spaces under sheds, houses, and other buildings. Block entrances with chicken wire buried at least 6 inches into the ground.

Another option is to place repellents such as ammonia-soaked rags or mothballs in burrows or where skunks have to pass to go in and out of their dens.

WILDLIFE MANAGEMENT

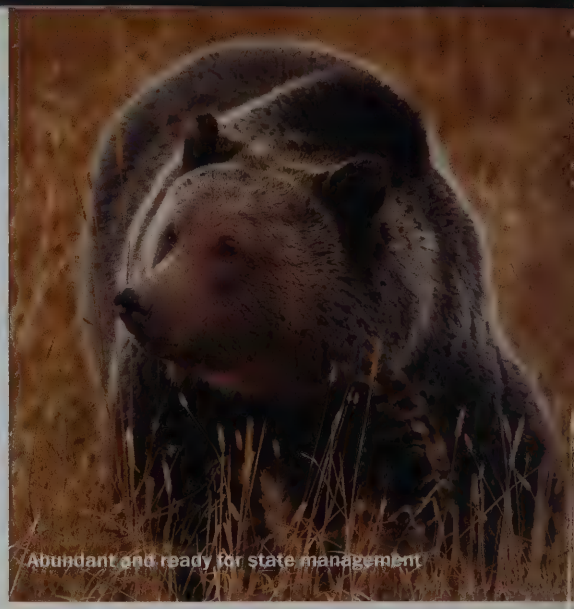
Yellowstone grizzlies proposed for delisting

After nearly 41 years under Endangered Species Act protection, the grizzly bear population in the Greater Yellowstone Area (GYA) has been recovered. In March, officials with the U.S. Fish & Wildlife Service proposed removing the grizzly bear in the GYA from the federal list of endangered and threatened wildlife. "I think what we have here is a tremendous success, and the Endangered Species Act has done its job," Fish & Wildlife Service director Dan Ashe said in a press conference. Montana FWP supports delisting the grizzly bear.

Once the delisting is final, management of the GYA grizzlies will transition to the states of Montana, Idaho, and Wyoming.

"The goal of the ESA is to recover threatened and endangered species and, with adequate monitoring and safeguards in place, return management to the states," says FWP director Jeff Hagener. "We've achieved this goal. All recovery criteria have been met, the population is recovered, and assurances are in place to maintain a healthy and viable population of bears in the GYA."

Learn where delisting would occur, why delisting is important, and how the bears would be managed in Montana at fwp.mt.gov. ■


Abundant and ready for state management

FISHERIES MANAGEMENT

Aiming for "just right" kokanee populations

Among the most popular fisheries in western Montana are the kokanee populations in scenic Alva, Inez, Seeley, Placid, and Salmon Lakes, in the southern part of the Seeley-Swan Valley. The challenge in managing these small landlocked sockeye salmon, says Missoula-area fisheries biologist Ladd Knotek, is to keep the total number within the right range. "Too many kokanee create stunting and slower fishing," he says. "Too few and the fish will be bigger, but unfortunately catch rates will be poor."

When kokanee are overabundant, Knotek explains, there are too many mouths to feed with the available forage—mainly microscopic zooplankton. As a result, the salmon reach only eight to nine inches. "You'd think more fish would mean better catch rates, but at that size a kokanee's mouth is extremely fragile and it's tough for anglers to hook and land them," he says. "Our goal is to provide quality fish of over 12 inches and high catch rates where possible."

Spawning kokanee

Kokanee were first introduced to the lakes in the mid-20th century. Today they are maintained both with stocking and natural reproduction. "Natural recruitment is a real wild card because it varies greatly from year to year and among waters," says Knotek. "It also depends on factors such as stream flow, overwinter conditions, predation, competition with other species, and availability of forage. We never know from year to year what the natural reproduction will be like."

FWP attempts to supplement natural reproduction with annual stocking to create just the right total population. Fisheries biologists and technicians regularly monitor the lakes' kokanee populations with netting, angler surveys, and spawning surveys to help determine if stocking rates should be decreased or increased.

"We're constantly working to adjust kokanee numbers, to the extent possible, to create fisheries that provide anglers with the best recreational opportunities we can," Knotek says. "We can control how many kokanee we stock, but we can't control the natural reproduction component. That's the big unknown." ■

CLOCKWISE FROM TOP LEFT: CARTOON ILLUSTRATION BY MIKE MORAN; JAIME & LISA JOHNSON; KENTON ROWE; JOSEPH TOMELLERI; SHUTTERSTOCK; SHUTTERSTOCK

FISHERIES MANAGEMENT

New Central Fishing District regulations

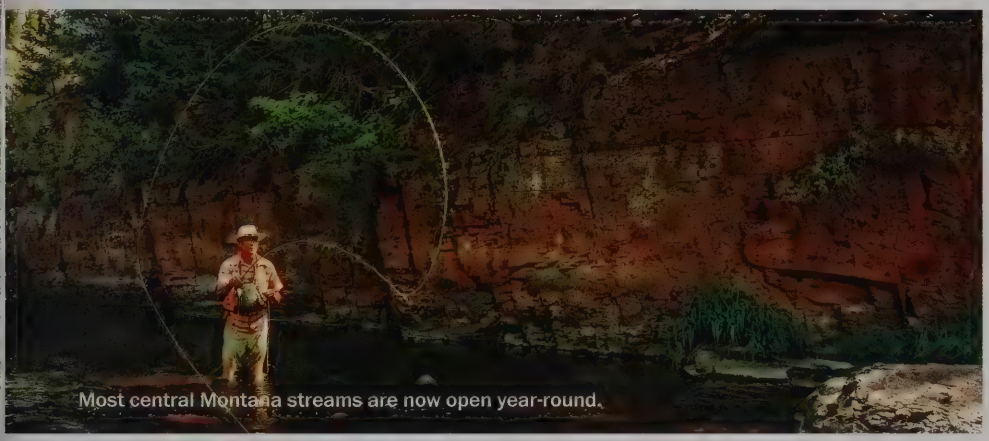
Two significant new fishing regulations that FWP instituted this year affect trout anglers in Montana's Central Fishing District.

The fishing season on rivers and streams in that district is now open year-round except where specified in the 2016 fishing regulations. In the past, many streams were closed to protect spawning fish from overharvest. "Instead of saying that most streams are closed except for these ones we list that are open, as used to be the case, we're now saying that all the streams are open except for certain exceptions," says Joel Tohtz, FWP Fisheries Management Bureau chief. "The idea is to make the regulations simpler and allow for more fishing recreation," he says.

Tohtz says that many tributaries now open to year-round fishing are in remote mountainous settings where overharvest is not a concern. "Even so, we'll monitor them, and if it seems as though some are receiving too much harvest during spawning season, we'll close them," he says.

Also, for the first time in decades FWP is allowing the harvest of westslope and Yellowstone cutthroat trout from streams and rivers in the Central Fishing District. The limit is one cutthroat in possession each day. "We've said all along that our goal with cutthroat conservation was not to create a museum species but one that anglers can start harvesting again," says Tohtz. "We're now at a point with restoration where many Central Fishing District cutthroat populations can sustain some harvest." According to Tohtz, anglers opposing the liberalized harvest regulation were concerned that some populations might be too vulnerable. "We'll watch those streams for problems, and we'll close them if necessary," he says.

Limited harvest of cutthroat 12 inches and under continues to be legal in Western Fishing District streams and rivers. ■



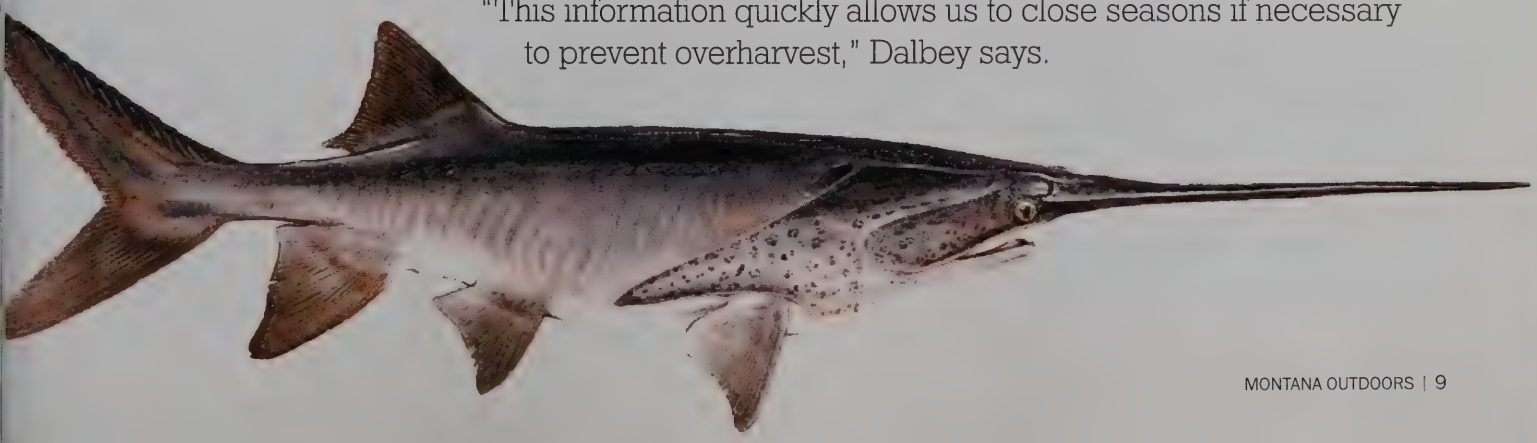
Most central Montana streams are now open year-round.

Lottery used for paddlefish harvest

Earlier this year, FWP held a lottery to allocate opportunities to harvest paddlefish on the Missouri River upstream from Fort Peck Reservoir. The lottery system will help the department provide equitable opportunities in the face of overcrowding in the Fred Robinson Bridge area, the site of most Missouri River snagging. "Last year we had nearly 1,000 people descend on that area on the first day of the snagging season, and that degraded the experience for a lot of families and others," says Steve Dalbey, FWP regional fisheries manager in Glasgow.

March 31 was the deadline for applying for the 750 Missouri River "white" harvest tags. "You can still buy a license over the counter allowing you to snag and release a paddlefish," says Dalbey. "But if you don't have a harvest tag, you can't take one home."

This is also the first year that paddlefish snaggers on the Missouri and Yellowstone Rivers and in the Dredge Cuts below Fort Peck Dam must report their harvest to FWP within 48 hours. "This information quickly allows us to close seasons if necessary to prevent overharvest," Dalbey says.



MUSSELSHELL MAKEOVER

How the people in this central Montana watershed found a way to share water from—and restore function to—the river running through their lives.

BY BRETT FRENCH PHOTOS BY JOHN WARNER

WANTED WATER Horses drink from the Musselshell where it bends beneath an old iron bridge west of Lavina. A lifeline for area farmers, ranchers, and towns, the river once had most of its flow diverted into upstream irrigation canals, pitting water rights holders against each other and threatening native fish.

Perched atop an irrigation pivot, a hawk scans a dense green corn crop the sprinkler has nurtured to an August height of five feet. From its aluminum roost, the raptor seems to be searching for movement, perhaps an unwary ground squirrel feeding along the field edge.

But it's the sprinkler, not the bird, that fuels 67-year-old Bob Goffena's memories of this lower region of the Musselshell River drainage. His thoughts drift to the human changes taking place on a once-dry landscape now lush, thanks to the river's water.

"That's the other thing the water commission did, it improved the crops you could grow," Goffena says admiringly from the passenger seat of a car stopped along Harvey Road, about 30 miles east of Roundup in central Montana. He speaks with the accumulated knowledge of a man who has served as a Musselshell County commissioner and Deadman's Basin Water Users Association board member.

The "commission" is Goffena's shorthand for the water commissioners of the Musselshell River Distribution Project. Before the project was formed and better

water appropriations were instituted, it was common for the Musselshell—which rises in the Little Belt, Crazy, and Castle Mountains and empties into Fort Peck Reservoir 342 river miles later (see map, page 14)—to dry up in its lower half. Because water allocation wasn't meeting all the needs of irrigators and municipalities, users up and down the river fought over who got water and when. Thrown into the mix were concerns about the river's fish that were stranded in shallow, tepid pools and struggled to move upstream or downstream past man-made barriers. The distribution project's system of water allocation—along with formation of a new coalition of watershed interests—is helping change how the Musselshell flows, how fish use the river, and how local communities view a waterway that affects so many lives.

NAMED FOR THE FATMUCKET

It's hard to conceive that an area where water is so scarce once sat beneath a vast inland sea. Relics of that ancient past are found in the region's thick coal seams, oil deposits, and the salt that still leaches from the soil. The Musselshell River, stretching along U.S. Highway 12 from Martinsdale east to Melstone and then north, is fed by young mountain ranges formed after the sea receded.

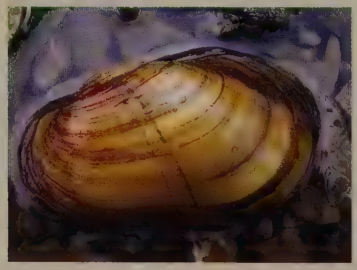
The valley has a long history of human habitation. Projectile points, pottery shards, and other archaeological evidence show that people lived in the Musselshell Basin as far back as 10,000 to 12,000 years ago. The river was first named in English by Meriwether Lewis as he traveled with the Corps of Discovery up the Missouri River in 1805 and noted freshwater mussel shells along the banks (see sidebar below). Next came trappers and hunters pursuing the region's abundant beaver and bison.

Recognizing the productivity of the Musselshell Valley, the ranchers and farmers who followed were quick to file for water rights—the first as early as 1869 for stock water and then in 1875 for irrigation. As the valley's population slowly grew, demand for water from the river and three reservoirs—Bair, Martinsdale, and Deadman's Basin—grew. So did disagreements over water rights. The feuds became so bitter that for decades directors of the major upstream and downstream water user groups refused to talk to each other.

> "Upstream users would look at the river at their diversion and tell me it just can't be true that there's no water down below."

During the severe drought of 1988, the river dried up just 10 miles downstream from Roundup, and Deadman's Basin Reservoir was nearly emptied. When the two water user groups met that summer, the meeting was crashed by irrigators who ended up in a shouting match over water allocation. "A lot of users were diverting water not supported by their water right without any regard for priority dates," says Goffena. "Upstream

Brett French is outdoors editor for the Billings Gazette. *John Warner is a freelance photojournalist who lives in Billings.*



Palm-sized hitchhiker

The Musselshell River's namesake is the fatmucket mussel, a palm-sized bivalve with a thick, yellow-brown shell. Mussels can't move far but extend their range by "hitchhiking." After mating, the female produces eggs inside herself that mature into larvae known as glochidia. She then waves soft tissue resembling an insect to attract a catfish or other fish species. When the fish tries to eat the lure, the mussel ejects her glochidia, which hook themselves to the fish's gills or skin. There they form into small mussels before breaking off and sinking to the stream bottom. Barriers to upstream fish movement on the Musselshell could prevent the fatmucket from fully occupying its historic range.

KANSAS WILDLIFE, PARKS & TOURISM

WATER FOR CROPS BUT BLOCKAGE FOR FISH FWP fisheries biologist Mike Ruggles examines a small rock diversion dam near Two Dot. "Behind me is where the impounded water gets diverted into an irrigation canal that ends up in pivot irrigation systems [facing page]," he says. "Trout can get over a little dam like this one, but native species like longnose dace and shorthead redhorse can't get past even something this low."

users would look at the river at their diversion and tell me it just can't be true that there's no water down below."

A big step toward resolving disputes came in the early 2000s with establishment of the Musselshell River Distribution Project. The project allowed the District Court to appoint four water commissioners, funded by water users, to monitor and enforce water rights. Now all water taken from the Musselshell is measured. That ensures no one diverts more than their legal right, while securing everyone's entitled share.

"The way they've solved this problem is a model for community-driven water distribution," says Bruce Rich, head of the Montana Fish, Wildlife & Parks Fisheries Division. "I could see it being emulated elsewhere to benefit both irrigators and aquatic resources."

WAY TOO LITTLE, WAY TOO MUCH The Musselshell River has suffered from both a dearth and an excess of water. For decades, over-diversions by upstream water rights holders left the lower half of the river dry by midsummer. That denied downstream irrigators their water and blocked migration essential to fish populations. In 2011, the Musselshell flooded with flows exceeding 30 times normal rates. Though disastrous to communities and landowners, the flood restored wetlands, created new fish habitat, and allowed upstream fish passage.

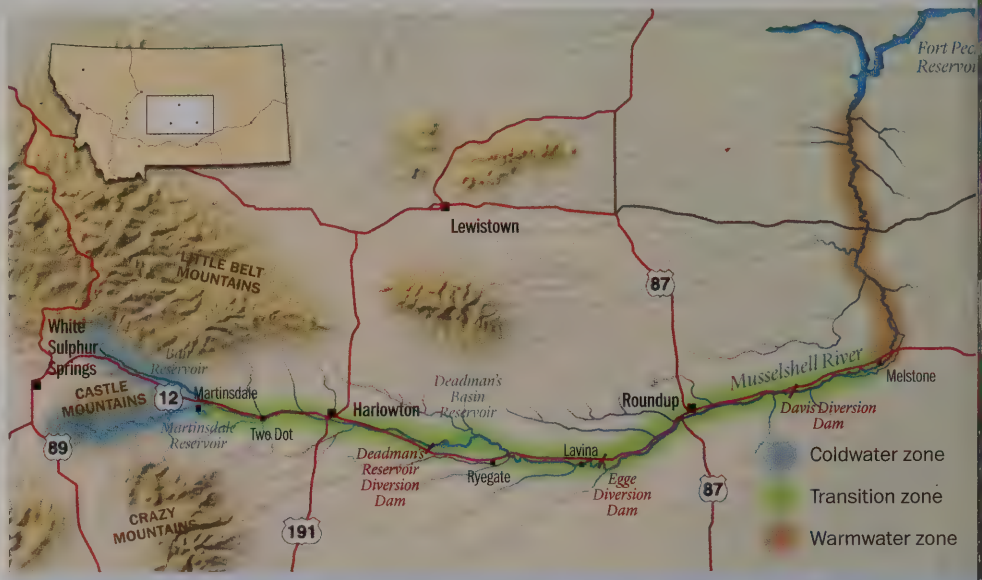
WIKIPEDIA

Dewatered Musselshell River, July 2010

CHRISTOPHER BOYER, KESTREL AERIAL

Flooded Musselshell River, June 2011

In 2009, the Musselshell Watershed Coalition (MWC) was formed to encourage collaboration among the basin's many water management concerns—agricultural producers, water user associations, and county, state, and federal agencies stretching across five counties. Bill Milton, a dryland rancher near Roundup who serves as facilitator for MWC, says it wasn't easy at first convincing the various players to cooperate. "But then people started to see that they can accomplish more working together than they can on their own," he says. "It makes it easier for government agencies when everyone agrees." That's important because the river's aging irrigation infrastructure, much of it built in the 1930s and '40s, needs repair. Milton adds that "telling a story about a whole river basin and its community" can help attract state and federal grant money.



CENTRAL MONTANA LIFELINE The Musselshell River Watershed covers approximately 9,500 square miles and is home to roughly 9,325 residents. The Musselshell River flows from the confluence of the North and South Forks near Martinsdale for 342 miles to Fort Peck Reservoir, providing water for farms, ranches, and municipalities. Established in the early 2000s, the Musselshell River Distribution Project ensures that water from the river is apportioned legally. Four water commissioners, funded by water users, monitor and enforce water rights holders.

STRAIGHTENING THE RIVER

A major chapter in the Musselshell story has been the river's channelization. During the first half of the 20th century, several large building projects forever changed the waterway: construction of the now-abandoned Milwaukee Road rail line in 1907 and, later, the building of U.S. Highway 12 and more than two dozen diversion dams—barriers that divert river water into irrigation channels.

The dams blocked migratory warmwater fish from historic habitat. The railroad and highway disrupted the Musselshell's natural processes. To protect the rail and road beds from erosion and make the routes as efficient as possible, engineers straightened the river. The rail and road beds created a dike, cutting off more than 80 meanders and shortening the Musselshell by 35 miles. The transportation infrastructure also severed the river from floodplains and wetlands, which historically absorbed floodwaters like a sponge.

Drivers travel more slowly on twisty roads than on ruler-straight freeways, and the same is true for water in streams and rivers. In May 2011, following days of heavy rains and massive snowmelt, the Musselshell turned into an aquatic autobahn, with river flows surging up to 30 times normal rates. Charging down the constricted, straightened river channel, water blasted through railroad bridges, carved around diversion dams, and gushed across roads and farm fields. "Channelization speeds up the river, and then there are no floodways to ease the water flows," says Mike Ruggles, an FWP fisheries biologist based in Billings. By June of that year, Governor Brian Schweitzer had declared a state of emergency for the basin.

> "Through the partnerships, we're restoring the river's native fish species and its natural heritage."

After the flood, the MWC formed a technical advisory team to assess the devastation and find ways to lessen economic, social, and ecological damage from future flooding. The coalition's partners organized emergency repairs and rehabilitations, from fixing irrigation infrastructure for immediate use to stabilizing streambanks and other long-term conservation projects.

Though it created enormous hardship by ruining homes, roads, diversion dams,

Mysterious species

The Musselshell River is home to a unique fish species, a hybrid of the northern redbelly dace and the finescale dace. The hybrids are all females that reproduce by breeding with male northern redbelly dace. Yet the male's sperm does not enter the egg but rather its presence stimulates development of the egg. Because the male's genetic material is never incorporated, offspring are all females and clones (genetically identical) of the mother. (Male northern redbelly dace also breed with females of their species, which produces both males and females.) Mysteriously, though northern redbelly dace are common in eastern Montana, not a single finescale dace has been recorded here.

ILLUSTRATIONS BY JOSEPH TOMELLERI

RIVER PEOPLE Top: At a cafe in Roundup, FWP biologist Mike Ruggles listens as Musselshell River advocate Bob Goffena explains how gauges along the entire river—like this one (above) monitored by Leon Hammond, project manager for the Upper Musselshell Water Users Association—help allocate water fairly and legally. Left: Anglers fish for channel catfish, sauger, and other species at a diversion dam 20 miles downstream from Roundup. During drought years, the Musselshell would often dry up from this point down to where the river empties into Fort Peck Reservoir, frustrating both irrigators and anglers along the way.

and cropland, the flood was a blessing for the Musselshell Valley ecosystem. It invigorated parts of the river by seeding new areas for cottonwood trees, toppled old trees into the river to create fish habitat, blew out fish-blocking dams, and restored water-absorbing wetlands. The disaster also helped unify the valley community and increase cooperation. "Attitudes have changed about working together," says Laura Nowlin, who was hired by the MWC with a state grant to set up meetings, produce a quarterly newsletter, and coordinate a watershed plan. "People in the watershed are more open to helping each other out."

> "Strengthen any one of those components, and you strengthen the entire system as a whole."

The flood served as a wake-up call that convinced many landowners to reevaluate traditional ways of using the river. For instance, many irrigators have found that portable electric pumps work as well or better than diversion dams to transport water from the river into irrigation channels. Pumps are far cheaper to replace than diversion dams—which one landowner calls "Mesopotamia technology"—if blown out by floods. They also don't block fish movement. "Pumps are good for fish and farms," Ruggles says. "An irrigator can turn them on and off from his house using a smartphone."

CAT MAN An angler shows off a hefty channel catfish caught beneath Davis Diversion Dam between Roundup and Melstone. Upstream-migrating fish stack up below the structure, which remains the biggest obstacle to fish movement on the entire Musselshell River.

The changes are aiding two state fish species of concern—sauger and northern redbelly dace—as well as channel catfish, burbot, shorthead redhorse, smallmouth buffalo, and more than a dozen other native nongame fish. "Through the partnerships, we're restoring the river's native fish species and its natural heritage," Ruggles says.

FOCUS ON FISH

Ruggles enjoys rooting for and working on the underappreciated Musselshell River. "People race right by here on the way to the Bighorn River," he says while standing at one of only two FWP Fishing Access Sites (FAS) on the entire river. The Selkirk FAS is near

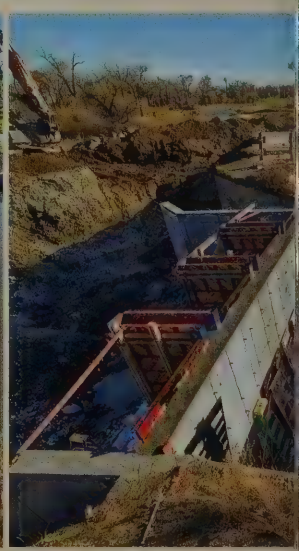
Better for irrigators and fish

About 25 miles east of Harlowton, the Deadman's Basin Water Users Association recently renovated the diversion dam that feeds Deadman's Basin Reservoir. The dam, which takes 600 cubic feet per second in spring, was rebuilt at a cost of $1 million, funded mostly by association members. FWP's Future Fisheries Program helped pay for a rock ramp that allows migrating fish to swim up and over the dam.

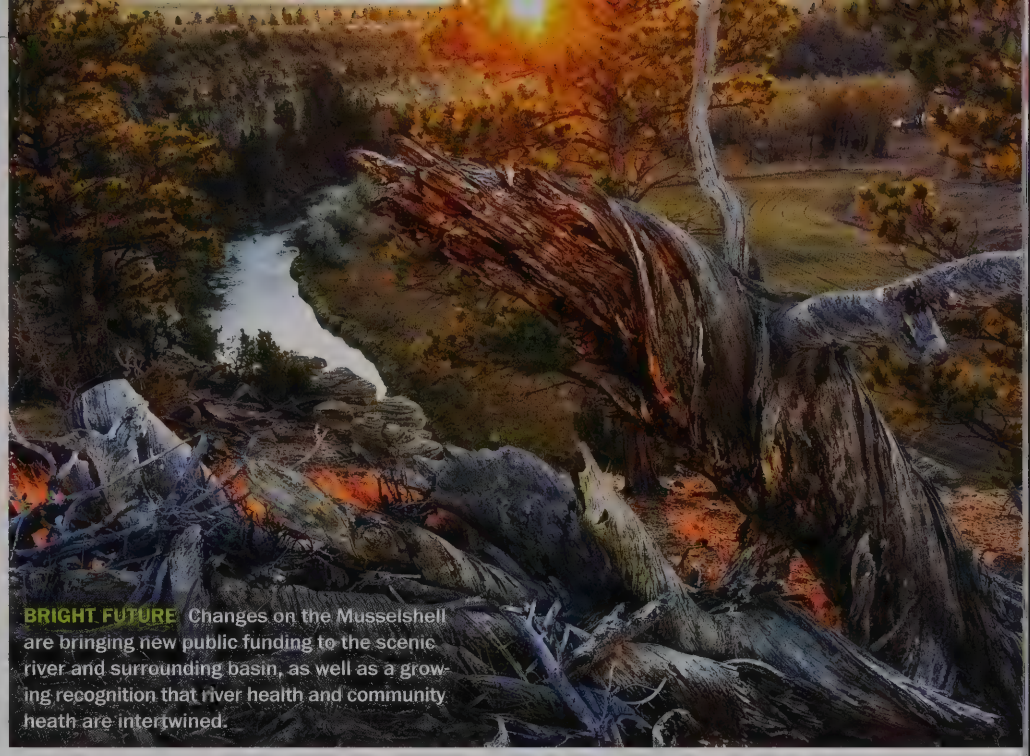
Because the headgate on the old diversion did not completely close, an estimated 3,000 acre-feet of water per year leaked into the 11-mile-long canal, where it disappeared into the ground. The water never reached the reservoir, a key storage basin for irrigation and a popular recreational fishery.

Soon work will begin on removing Egge Diversion Dam, five miles east of Lavina. The 2011

Deadman's Reservoir Diversion Dam before reconstruction



During reconstruction, October



BRIGHT FUTURE Changes on the Musselshell are bringing new public funding to the scenic river and surrounding basin, as well as a growing recognition that river health and community heath are intertwined.

Two Dot on the river's upper reach, which contains between 200 to 400 brown trout per mile, averaging 12 to 16 inches long.

Just downstream from the town of Harlowton, the river begins its transition to a warmwater fishery. Here—with cooperation of a landowner—Ruggles is reintroducing channel catfish. Last fall he and FWP crews trapped 20 catfish farther downstream near Fort Peck Reservoir and put them here, hoping they will reproduce. Over the next couple of years, Ruggles plans to relocate 150 to 300 more catfish. "This area has great minnow populations and suckers for forage. But because they were cut off from the Missouri by years of dewatering, catfish in this stretch never could get established," he says.

FWP studies in eastern Montana have shown that catfish will swim long distances to find the seasonal habitats they require, sometimes several hundred miles per year. "With diversion dams and dewatered areas, like were common here for so long, channel catfish couldn't migrate like they needed to," Ruggles says.

LOOKING AHEAD

The picture isn't all rosy on the Musselshell. The rail bed still cuts off much of the river from its historic meanders. The 2011 flood spread salt cedar, knapweed, and other invasive plants widely throughout the floodplain. With so many diversion structures damaged, many farmers and ranchers still struggle to obtain water for alfalfa and corn fields. And not everyone is sharing water. "Some people are still diverting more than is represented by their water right," Goffena says during a drive down the valley.

Despite the setbacks, more water is making its way down the Musselshell River than in years past. That benefits downstream irrigators and fish. And if additional obsolete diversion dams are removed or the necessary ones are modified, says Ruggles, native sauger could eventually make their way upstream from the lower Musselshell to the middle part of the Musselshell, where they haven't been seen in decades.

The fisheries biologist is optimistic. He notes that residents of the Musselshell Basin are realizing that a healthy river and healthy communities go hand in hand. "The same water that helps keep farming families on the land is helping native fish," he says. "Many people in this region are now looking at the big picture of the Musselshell." That means recognizing that the entire system—the river, the fish, the local economy, the community—are interconnected. "Strengthen any one of those components," adds Ruggles, "and you strengthen the system as a whole."

Renovated dam with rock ramp (arrow) for fish passage, February 2016

flood did an end-run around the dam, carving into a farmer's field. Removing the concrete structure will reconnect 24 miles of river.

The biggest remaining obstacle to fish movement on the Musselshell is Davis Dam, about 12 miles downstream from Roundup. FWP fisheries biologist Mike Ruggles hopes that someday the dam can be removed or a bypass stream built around the structure. "We definitely don't want to see all the diversion dams on the Musselshell gone," says Ruggles. "Some of them, like Deadman's Basin, are essential for irrigation. And from a fisheries standpoint, some are doing a good job of preventing non-native northern pike from moving up from Fort Peck Reservoir into the river system and preying on native fish. But we definitely would like to see Davis Dam taken out or altered to allow some fish passage."

UGLY DISCOVERY AT SWAN LAKE

The Fish and Wildlife Commission takes an unprecedented step to stop illegal fish introductions after walleyes are found in a scenic northwestern Montana lake. By Tom Dickson

Last October Leo Rosenthal was working with a commercial netting crew to remove lake trout from Swan Lake. As the workers pulled fish from a mile-long gill net used to capture lake trout spawning on shallow underwater reefs, a crew member called out to Rosenthal that he'd found a walleye in the mix. Never before had that species been documented in Swan Lake. "Of course it was disappointing," says Rosenthal, FWP fisheries biologist for Swan Lake. "But I can't say I was surprised."

Disappointing, because the 17-inch walleye—along with another of the same size netted a week later—could indicate the presence of a reproducing population in the scenic lake, which sits across the Mission Mountains from Flathead Lake in northwestern Montana. If they became established, walleyes could threaten the lake's famous kokanee salmon and bull trout populations. Both species are already under siege from overabundant non-native lake trout. FWP has been testing removal techniques on the voracious lakers by contracting with commercial netters for the past seven years.

Rosenthal's lack of surprise came from knowing that illegal fish introductions are increasing. FWP has documented more than 500 illegal introductions in lakes, reservoirs, ponds, and rivers since the 1980s. The Swan Lake planting is the 11th illegal walleye introduction that FWP has documented west of the Continental Divide, and it's likely other attempts have been made but remain undetected. "Far too often we've seen non-native fish show up in lakes where they've never before been found, putting existing fisheries at risk," Rosenthal says.

Swan is one of only a handful of lakes in Montana containing a robust population of bull trout, a federally threatened species. The lake is also home to a popular kokanee fishery. The small salmon, averaging 10 to 12 inches long, are considered delicious and often bite eagerly.

The only good news from Swan Lake is that the two walleyes did not originate there. When FWP scientists analyzed chemicals in the growth rings of the fish's ear bones, or otoliths, they found that the three-year-old walleyes did not grow up in Swan Lake. Rosenthal says that if the fish had originated from Swan Lake, that meant a reproducing population had established itself. "That's not to say there isn't one there now," he says. "But at least it's still only a possibility and not a certainty."

FWP biologists are comparing chemical traces in otoliths of fish in other Montana lakes to those in the two walleye otoliths to see if they can learn where the illegal fish originated. "Then we can focus attention on that lake and see if we can find out, maybe through a call to our TIP-MONT hotline, who made the illegal introduction at Swan Lake," says Mark Deleray, FWP regional fisheries manager in Kalispell.

WORRISOME TREND

Other illegal fish introductions have threatened fisheries across western Montana, particularly in the Seeley-Swan Valley. In 2014 smallmouth bass were illegally placed in Seeley Lake. Northern pike were unlawfully dumped into Salmon and Seeley Lakes in the early 1990s. The pike have since spread downstream into the Blackfoot and Clark Fork Rivers, where they feed on brown, rainbow, and cutthroat trout. Illegally planted non-native brook trout have damaged Clearwater Lake, one of Montana's top westslope cutthroat fisheries.

In Noxon Rapids Reservoir, on the lower Clark Fork near the Montana-Idaho border, illegally introduced walleyes threaten the lake's renowned smallmouth bass, largemouth bass, and perch fisheries, as well as westslope cutthroat and bull trout populations. Biologists report that walleyes and other predator species have already put a big dent in forage fish populations such as peamouth, yellow perch, and northern pikeminnow.

Deleray says anglers who illegally introduce new predator species might believe that the new species simply provide additional recreation. "But those

UNWELCOME IN TROUT WATER Last fall commercial netting crews discovered two walleyes in Swan Lake. FWP biologists fear that a reproducing population of the predator could compete with the lake's federally endangered bull trout and reduce its popular kokanee salmon fishery.

LEFT TO RIGHT: JEREMIE HOLLMAN; ERIC ENGBRETSON

fish actually decrease fishing opportunities by taking food away from existing fish," he says. "These lakes already have a natural balance between predator and prey fish. Add more hungry predators like walleye to Swan Lake and they could impact the kokanee population, a food source for bull trout."

New species can ruin existing fisheries, robbing other anglers of recreational opportunity and threatening native fish populations and federally protected species. "When we are forced to go in and try to fix the problem, it's extremely expensive work, and then all anglers get stuck with the bill," says Bruce Rich, head of the FWP Fisheries Division.

CASH FOR CONVICTIONS

Alarmed over the threat to popular, economically valuable fisheries, the 2011 Montana Legislature doubled the fine to $10,000 for those convicted of illegally introducing fish. Lawbreakers could also face jail time.

Tom Dickson is editor of Montana Outdoors.

Unfortunately, catching someone in the act is difficult. Most lakes are in sparsely populated areas, where fish can be easily transferred from one lake to another without notice. To encourage citizens to turn in skofflaws who illegally transport fish, major conservation groups and outfitting organizations have pledged a total reward of more than $20,000 for information leading to successful prosecution. The Fishing Outfitters Association of Montana, Invasive Species Action Network, Montana B.A.S.S. Federation Nation, Montana Pike Masters, Montana Trout Unlimited, Montana Wildlife Federation, Walleyes Forever of Montana, and Walleyes Unlimited of Montana contributed to the reward. Another $1,000 is available through FWP's 1-800-TIP-MONT violation report line.

Montana Trout Unlimited is also offering an additional reward of $10,000 for tips leading to the conviction of those who illegally introduced walleyes into Swan Lake, walleyes into Noxon Rapids Reservoir, or smallmouth bass into Seeley Lake.

> "All that work is compromised by the selfish acts of a few criminals."

Bruce Farling, TU Montana director, says his members are angry. "We've spent decades working with landowners, FWP, communities, and other anglers to protect and restore coldwater fisheries, and then all that work is compromised by the selfish acts of a few criminals," he says. Bob Gilbert, executive director of Walleyes Unlimited of Montana

REWARDS OFFERED Swan is one of only a few lakes in Montana with a healthy population of bull trout. Concerned about the threat to that species as well as other native species and game fish, Trout Unlimited and other groups have pledged a reward for tips leading to the conviction of those who illegally introduced fish into Swan Lake, Seeley Lake, Noxon Rapids Reservoir, and other waters.

HIT HARD The Seeley-Swan area has been the site of several potentially damaging illegal fish introductions. Unprecedented new FWP harvest regulations at Swan Lake (south end shown here) are aimed at removing any food harvest or trophy fishery potential as a disincentive to potential lawbreakers.

and a former state legislator, notes that his organization has long denounced illegal fish planting. "We adamantly oppose anyone taking the law into their own hands," he says.

PLAYING HARDBALL

In December 2015, the Fish and Wildlife Commission took an unprecedented step by requiring anyone who catches a walleye in Swan Lake to kill it immediately and then turn the entire fish over to FWP. "The regulation is meant as a major disincentive," says Deleray. The new law prevents anglers from taking their catch home to eat. And those who prefer to catch walleyes and then release them to grow larger won't benefit either because the new must-kill requirement prevents establishment of an illegal trophy fishery.

"This is hardball, no doubt about it," says Deleray. "It shows how seriously the commission and we in FWP take this issue. To those thinking about making illegal fish introductions, this regulation is saying, 'Don't take the risk, because you won't get what you want out of it.'"

MORE MOUTHS TO FEED When illegally introduced to a lake or reservoir, smallmouth bass (left) and northern pike (right) take food away from trout and other game fish already in those waters.

CLOCKWISE FROM LEFT: MICHAEL L. HARING; CHRIS BOYER; LUKE DURAN/FWP; ERIC ENGBRETSON; ROBERT S. MICHELSON

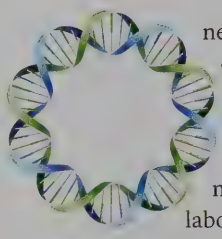
REPORT OUTLAW FISH INTRODUCTIONS

If you have any information on the walleye introduction at Swan Lake or any other illegal fish plantings, call 1-800-TIP-MONT (847-6668). Informants may remain anonymous. If the information leads to a conviction, informants could be eligible for cash rewards of up to $30,000.

MAKE THE CALL:
1-800-TIP-MONT

We know you're in there

Geneticists use new eDNA science to quickly and accurately identify fish species in streams and lakes and trace the origins of individual fish. **By Ladd Knotek**



One of the toughest challenges of fisheries management is monitoring fish populations. While mostly effective, traditional techniques like gill netting and electrofishing are labor intensive, time consuming, and often don't pick up species low in abundance. Biologists have long hoped for a new and better way to find fish to complement our usual tactics.

Now we've found it in environmental DNA analysis.

Environmental DNA (eDNA) is the fragments of genetic material naturally shed by plants and animals into their environment. In the case of fish, eDNA is found in the cells of body mucous, scales, and skin that end up in streams, rivers, and lakes. The eDNA is unique for each species and can be detected in very small amounts by genetic scientists.

Using eDNA analysis, Montana Fish, Wildlife & Parks fisheries biologists are able to quickly confirm if a certain species is present in a stream. All we need to do is take a water sample to a lab, where geneticists look for that species' unique DNA. Let's say we want to learn which tributaries of a river contain native westslope cutthroat trout. We collect water at various points along a tributary, send the samples to a genetics lab, and soon learn which streams hold cutthroat. Then we follow up with electroshocking to learn more about the cutthroat trout populations, such as sizes and ages of fish. We save time and money because we don't have to survey every tributary.

Sometimes biologists need to remove aggressive non-native brook trout from a stream so they can restock it with genetically pure westslope cutthroat. It's an expensive and difficult operation. Before eDNA analysis, we could never be sure we removed all the non-natives. We would sometimes stock cutthroat only to find, a few years later, that some brook trout had survived and were again outcompeting the native species. Environmental DNA analysis gives us greater confidence in how well our eradication efforts are working.

FWP is also using eDNA sampling to monitor for invasive species such as Eurasian watermilfoil and zebra mussels and to identify illegal fish introductions. Controlling unwanted plant and fish infestations is much easier if caught early, before the species can gain a foothold in a lake or river. In lake-rich northwestern Montana, FWP crews and volunteers use eDNA analysis to regularly test lake outlets for unwanted plants and aquatic organisms.

Tracking sauger

In central Montana, FWP fisheries biologist Mike Ruggles hopes that eDNA analysis will help him track the progress of sauger now returning to historic reaches of the Musselshell River. FWP is trying to restore the native species after several fish-blocking diversion dams were blown out by a 2011 flood and a fish passageway was recently installed on a newly rebuilt dam. Kellie Carim, eDNA coordinator at the National Genomics Center for Wildlife and Fish Conservation in Missoula, developed a genetic "marker" that identifies sauger. In the future, when Ruggles sends Musselshell River water samples to the lab, Carim and her colleagues will use their marker to see if sauger are making their way upstream.

Using eDNA analysis has its limitations. It can't tell you how many fish are in a stream or their size or age. To gather that and other information essential for fisheries management, FWP fisheries biologists continue to

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Ladd Knotek is an FWP Missoula-area fisheries biologist.

use electrofishing, netting, and other traditional fish sampling techniques. And eDNA can't tell scientists about genetic diversity and purity within a fish population. For that, we still need to obtain and examine the DNA in tissue from multiple individuals in a fish population. But when we want to quickly and inexpensively learn if a certain species is in a stream, we now have an accurate tool.

When we want to quickly learn if a certain species in is a stream, we now have an accurate tool.

Population "fingerprint"

In northwestern Montana, biologists are using a different DNA technique called "genetic assignment" to trace an individual fish to its tributary of origin or source population. Geneticists compare genetic markers from an individual fish with the presence and frequency of these markers in the tributary populations where the fish may have originated. In one recent application, FWP biologists wanted to learn from which specific tributaries individual bull trout in lakes of the Clearwater Basin (Seeley-Swan area) originated. The information will help us identify the relative importance of the various spawning tributaries in a watershed so we can decide where to focus conservation projects.

FWP fisheries crews collected genetic samples from juvenile bull trout in all five Clearwater Basin bull trout spawning tributaries. Geneticists then identified a distinctive genetic "baseline"—or unique genetic "fingerprint"—for each tributary population.

Next, we collected tissue samples from bull trout captured by ice fishing in lakes throughout the system and then released. By comparing the genetic make-up of each fish with the distinctive genetic characteristics of baseline populations in the tributaries, we learned which tributary each trout came from. With that cumulative information, we can steer future conservation work toward the most productive and important tributaries.

By taking a fin clip, we can also learn how far an individual fish travels. For instance, we now know bull trout from the Blackfoot River system move up into the Clearwater system. That information helps us make a strong case for projects on the Clearwater to improve fish connectivity because the work will also benefit Blackfoot River fish.

Advances in genetics science are allowing FWP to conserve and manage Montana's native species more rapidly, accurately, and effectively than ever before. We still use old-fashioned nets, electric currents, and even hook-and-line angling to learn about fish in lakes, streams, and rivers. But, increasingly, some of our most valuable information on native fish populations and individual fish comes from a genetics laboratory.

WHERE THEY CAME FROM Facing page: Kellie Carim of the National Genomics Center for Wildlife and Fish Conservation takes water samples on a northwestern Montana stream. Top: Back at her lab in Missoula, the geneticist analyzes the water for environmental DNA from bull trout. FWP used the analysis to determine the origins of bull trout caught and released in Seeley Lake, like this one (right) from Morrell Creek.

LEFT TO RIGHT: MIKE SCHWARTZ; KATIE ZARN; MONTANA FWP

Chucking Big Buggers for Big

There are many methods for taking large trout with a fly. Some even work. In a vain quest for angling immortality, I have tried most techniques. Over the years my favorite, both in terms of success and fun, has been to use a Woolly Bugger. I've caught more big trout on this streamer than all other patterns combined (which may be partially a function of the amount of time I use it). I'm convinced the Woolly Bugger succeeds because it mimics so many foods that big trout eat: large stonefly nymphs, sculpins, dace, and crayfish. As it flutters and pulses or even just dead-drifts through a run or brushy bank, a Woolly Bugger looks like something a fish would want to devour.

I first learned just how effective buggers can be more than 25 years ago one October day on the Bitterroot. John Talia, my sometimes angling mentor, showed me how truly wicked they could be in taking large brown trout. Back in those days, we had the river pretty much to ourselves. John knew anyone else we'd run into, one or two other outfits at the most. We'd all say, "Hello," talk about the fishing, the weather, the baseball playoffs, and then go our merry ways.

About halfway through the float, John pulled the boat onto a wide gravel bar formed directly below an enormous, emerald pool that must have been over a dozen feet deep. John tied on a heavy black bugger. He cast the fly far up the pool along the inside bank, where he allowed it to sink, roll, and twist its way to the bottom. The bugger worked around in the eddy for a long time—nearly a full minute—before John stripped in most of the slack and started to impart life to the imitation with quick jerks of his line. After the third pull he felt a powerful tug in the opposite direction. When John lifted his rod to set the hook, an enormous brown blasted through the water surface before running and then leaping back and forth across the pool. After a few minutes, he brought the fish to the shallows near shore.

"Hell of a brown, Talia," I said. "What do you think? Twenty-six inches?"

"I'd say 23 or 24, but the thing is a boxcar," he said and laughed. "This brown's as thick as I've seen in a long time. Four pounds anyway. Buggers are the best when they sink down and dredge the bottom. The big ones can't resist."

I followed his lead, casting my bugger downriver and across, letting it sink, then stripping the fly. I was immediately into a trout that turned out to be a brown just short of 20 inches. Using buggers for the remainder of the float, we caught a number of sizable browns, rainbows, and one fat westslope cutthroat. I was sold.

From that point on, I worked on learning how to use Woolly Buggers and other big, ugly streamers, a process that didn't take long. Soon I was catching more large trout. As the years sped by, I refined the process to the point where, no matter where, when, or under what conditions I fish, I always catch at least one or two big trout, usually browns, using a brown, olive, or black bugger. I'm convinced it is the best, most consistent fly pattern for big brown trout.

Trout on the feed

By "big" browns, I mean fish that are larger examples of this species in a particular water. For most rivers, these are fish over 20 inches long.

Why do buggers work so well for big browns in particular? As they mature, brown trout switch from eating tiny insects to

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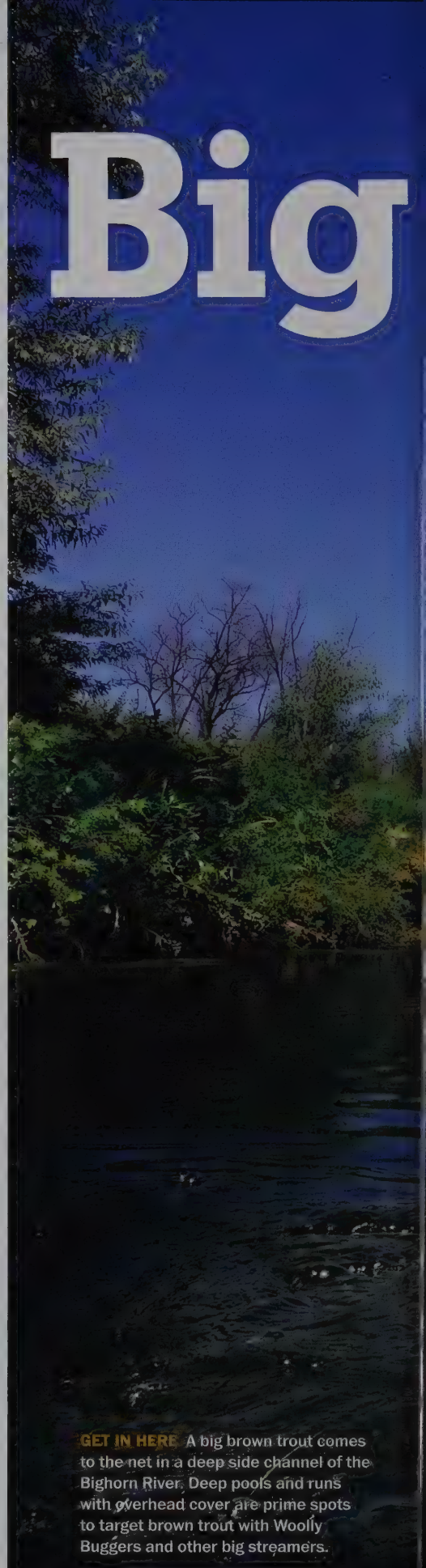
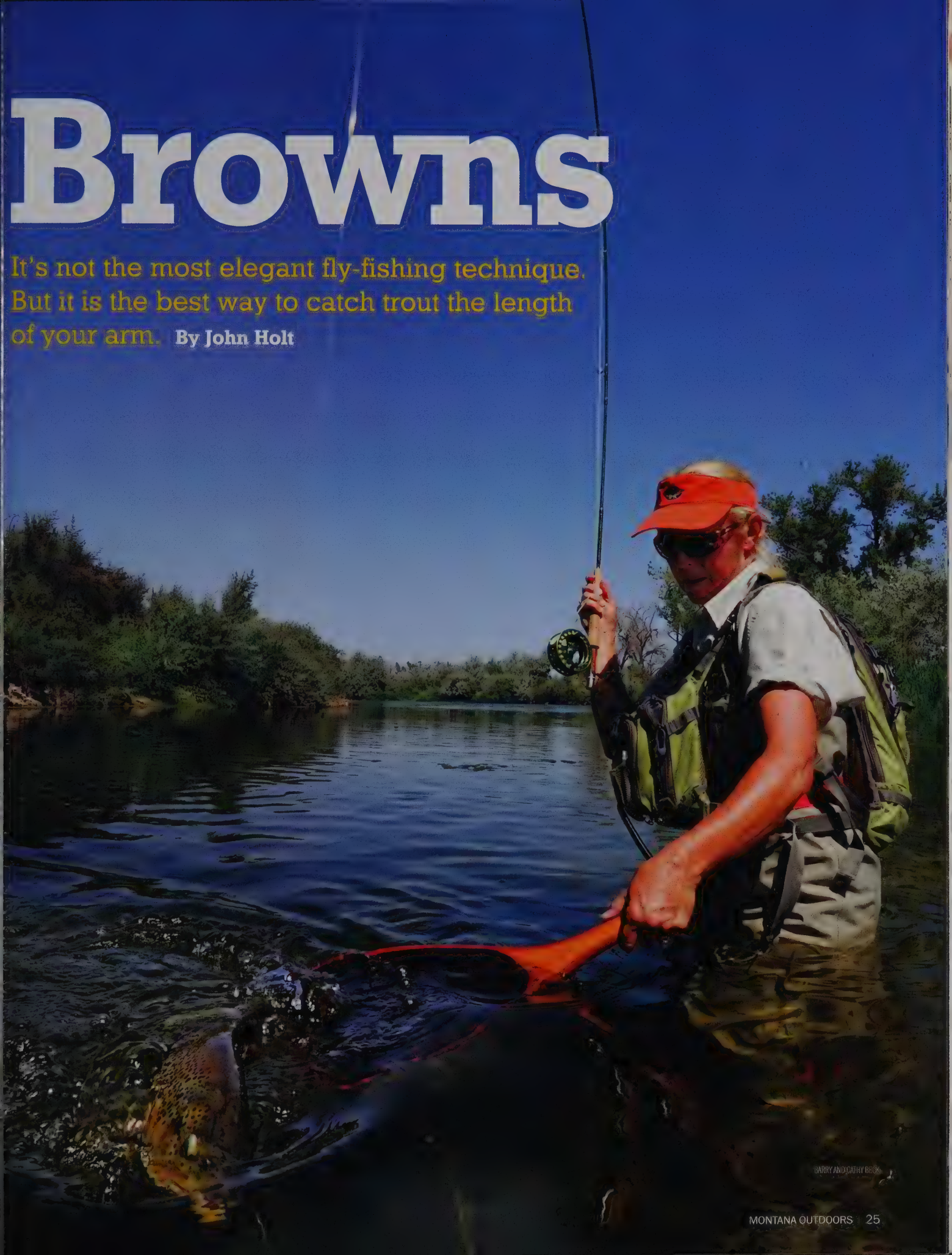
John Holt is the author of several Montana trout fishing books including Stalking Trophy Brown Trout. *He lives in Livingston.*



GET IN HERE A big brown trout comes to the net in a deep side channel of the Bighorn River. Deep pools and runs with overhead cover are prime spots to target brown trout with Woolly Buggers and other big streamers.

Browns

It's not the most elegant fly-fishing technique. But it is the best way to catch trout the length of your arm. **By John Holt**



BARRY AND CATHY BECK

consuming much bigger prey. Big rainbows and cutthroat also feed on larger foods, but not to the extent that browns do. Another reason is that browns don't tolerate bright sunlight as well as other trout species, spending much of the day in deep holes, under submerged trees, or along undercut banks. You need a big, heavy fly to get to those fish.

As for time of day and weather conditions, I've occasionally taken browns in bright sunlight in the middle of a July afternoon by dredging my bugger deep. But usually, the nastier the weather the better. When the sky has lowered and rain or even autumn snow moves in, browns become less wary and buggers become deadly. During these conditions, time of day doesn't matter, but in fair weather, early morning or dusk and later are best. Lower light levels offer the illusion of security for feeding trout.

One of the best times to catch big browns on buggers is just after spring runoff. All trout in a river, big and small, are moving into feeding lanes to gorge on insects and smaller fish unavailable or hard to catch in the roiling waters of the snowmelt surges. The mountains of ice and snow have melted and washed away to the Pacific. Rivers and larger creeks no longer resemble flood footage from the Weather Channel. Now they are in an easygoing summer mood, running with soft burbling sounds, afternoon sunlight bouncing off the riffles and lazy seams in the current.

Big, ugly patterns

On the small river I'm fishing this afternoon, Steller's jays squawk loudly among themselves over something important, maybe a dead field mouse, as they jump around in the pines and aspen. Several deer, fluffy white tails flicking, always flicking, graze lazily on the fresh green grass in the wide, open meadows next to the river. The slightest, softest touch of warm breeze curls around the valley, drifting across the flats and slipping through the pines. The water pushes easily against my legs as I wade slowly across the gravel bottom, out to a position where I can reach a deep run along the far tree-lined, brushy bank. The bank here is deeply undercut, water running in the darkness, swirling among clumps of exposed roots. Very big browns hold here, but they are hard to move. It's tough to get their attention with so much food—minnows, nymphs, drowned crickets—floating right into their big jaws. A large pattern, in this case a size 4 brown Woolly Bugger, tied with a mixture of golden brown, tan, and off-white feathers in a Palmer hackle, is my favorite pattern. The Palmer hackle makes the feather filaments stick straight out from the hook shank, causing them to pulse in the current like a living creature when the pattern is retrieved in short jerks. To give the bugger weight, I wrap the hook with a dozen twists of thick .035 wire, tie the fly to a 2X tippet, and pinch a split shot onto the tippet at the knot against the eye of the fly.

Other big, ugly patterns like the Marabou Muddler, Clouser Minnow, and Matuka Sculpin also work well. The key is to use a streamer pattern you believe in. That allows you to maintain concentration and determination during the inevitable long periods when you are not catching anything but need to be ready should a fish strike. This is important, especially in the often rough weather of early spring and late fall. Cold wind, rain, sleet, and snow can douse the flame of even the most diehard angler. Faith in your fly can keep the candle lit.

When fishing the Woolly Bugger, I get it down deep to where big browns hang out. A strong tippet and leader ensure I can horse a trout through any tree roots and strong current into the open where I'll have a chance at playing the fish, perhaps tiring it, and bringing it to my feet. This afternoon the water on this big river looks the same as it always does to me, full of promise and mystery.

SUN SHUNNER Browns don't like bright light and seek the shade of overhanging banks, submerged trees, or deep water. Big browns feed on minnows, sculpins, crayfish, and large nymphs. A Palmer-hackled Woolly Bugger (right) will pulse in the current like a live creature.

Down and deep

I move into position and begin working line out to cast far enough for the bugger to drift long enough to sink down deep under the far bank. Along the bank of the river runs a line of foam, indicating a conveyor belt of current delivering a steady supply of food to the fish below. The fly plops into a small eddy just above the bank and sinks down into the darkness. I maintain contact with the fly by gently keeping light tension on the line as the bugger works down to near the bottom. I keep the rod tip just above or even in the water, pointing it toward the route the underwater fly is following. Lifting the rod tip would bring the bugger to the surface, which I don't want. I can now feel the fly bouncing off rocks by the gentle but slightly rough pings transmitted through the line, the rod, and my hand. Then the fly pauses. At first I think it's caught on a wad of tree roots, which I know from past experience are down there and hold some big fish. But then I feel a slight tug, ever so slight, and I know it's a trout. I pull my

TOP TO BOTTOM: BILL BUCKLEY; GINNY HOLT; JOSHUA BERGAN

rod back quickly and firmly upstream, parallel to the water, to set the hook. Then comes a throbbing that jumps up the line as the brown rattles its head and tries to pull even farther back into the tangle and undercut.

I steadily back away from the bank, giving the big fish no line, until I feel the branches of willows brushing my back from the bank behind me. The powerful trout fights to stay deep in the pool, and it's like dragging a brick through thick cement. Then the line slackens—have I lost the fish?—but only because the brown has raced toward the water surface. The huge fish, wild and angry, rips clear of the river, shaking its broad flanks and sending water droplets onto the grasses nearby. The trout slams back into the river with a splash before leaping and crashing downstream, sucking line out of my reel until I'm into my backing. I clatter along the bank and thrash through knee-deep water, chasing the fish, rod pointing directly at its fleeing form. Forty yards below me the trout stops, sounding the depths of a deep pool.

"Got you," I say to no one.

The brown holds steady, then flies into the air once again before trying to make another run. But each attempt to break free becomes shorter, weaker, until I finally pull the tiring trout to my feet. I drop to my knees in the water as I always do when I want to touch a truly special fish. Sliding my hands into the river and along the brown's belly, I measure its length against a mark on my rod—later tape-measured at 24 inches. The fish is heavy, solid, and muscular, colored in gold, rich brown, copper, and crimson with black spotting and light fin tips. I twist the bugger from the upper jaw, keeping my fingers away from the wicked rows of large, razor-sharp teeth, and wonder at the powerful perfection of this fish. I watch for several seconds as the sunlight glows around the trout's body like an aura. The fish holds motionless in the water, perhaps aware that its fate now hangs in some strange, far-off balance. I ease it back toward the depths of the river, pointing its head into the current so it can be revived by the flow of water through its gills. Returning energy vibrates through the trout's body to the tail and up into my hands. I let go and watch the fish slowly swim off and disappear into the darkness on the other side of the stream.

The key is to use a streamer pattern you believe in. Faith in your fly can keep the candle lit.

Sure, catching trout with dry flies is a blast. But there is something intoxicating about probing dark, hard-to-reach runs, undercuts, and logjams with a Woolly Bugger. That's especially true in the fall, when browns become territorially aggressive and big rainbows and cutthroat beef up in preparation for the cold, hard times of winter, all of them attacking streamers with abandon.

Though spring and fall are best, the bugger works well any time of year. No matter the season, I can tie on this bulky pattern with confidence that, played down deep into the dark water where arm-length trout lurk, I will eventually make contact and feel that throb in my fly rod that mirrors the hard beating of my heart. Using Woolly Buggers is fly-fishing's version of hunting for big game. Nothing gives me more pleasure.

TO FIGHT ANOTHER DAY A spent two-foot-long spawning brown is revived in the current before release. Big fish like these rarely take a fly from the surface and are usually caught in deep holes.

RACEWAYS TO THE RESCUE

The surprising story of how FWP fish hatcheries help Montana conserve native populations and restore federally listed species.

By Paul Queneau

When it comes to antlers, local genetics can be easy to spot. Certain areas produce wide- or spindly antlered whitetail bucks, while other areas are more likely to grow bucks with narrow or heavy racks.

Genetic differences in trout species are usually not so obvious.

Matt Boyer has spent 13 years working to conserve the genetic diversity of westslope cutthroat trout in northwestern Montana, first as a Montana Fish, Wildlife & Parks fisheries biologist and now as the department's Fisheries Science Program supervisor. To the casual observer, individual westslope do not differ much in appearance. But Boyer says populations of these fish can actually be more genetically divergent from one drainage to the next than dog breeds are to one another, more distinct even than a Chihuahua is to a Labrador retriever.

In other words, looks can be deceiving.

The same can be said of Montana's hatcheries that focus on native fish conservation. On the surface they resemble concrete fish farms. Yet the work inside these unassuming facilities aims to safeguard and support the future of wild native fish populations across the state, including one imperiled species almost entirely dependent on hatcheries for its survival.

"A TROUT WAS A TROUT"

The main reason few people know how hatcheries contribute to fish conservation is because, for the first half of the 20th century, stocking in some cases actually harmed native populations. Starting in the early 20th century, employees of the Montana Department of Fish and Game, as the agency was known then, delivered by horseback milk cans filled with live fish to high mountain lakes with the aim of creating new sport fisheries. The fish came from hatcheries and were typically the breeds easiest to obtain at the time, usually non-native rainbows. "A trout was a trout in the early part of the 1900s, and the state was stocking whatever fish were available," says Boyer.

Stocked rainbows migrated into nearby streams and rivers and began interbreeding with native cutthroat trout, producing hybrid "cutt-bows" and diluting genetically pure populations. Stocked brown trout, lake trout, brook trout, and kokanee often outcompeted cutthroat and other natives already struggling from the effects of dams, stream dewatering, and pollution. In some cases the results were catastrophic. Pure westslope cutthroat are now limited to less than 10 percent of their historic range in Montana, in large part because of hybridization.

By the latter half of the 20th century, FWP started to recognize that many native fish species were in trouble, and that in many cases willy-nilly stocking was to blame. Biologists and hatchery managers gradually reassessed how they might alter fish-rearing tactics while still helping sustain sport fisheries that had become extremely popular with generations of anglers. "It really was an evolution of fishery management," says Boyer. "As we developed a greater understanding of native species and genetic adaptations and their conservation value, we developed a new appreciation."

Since the early 1980s, seven of FWP's twelve hatcheries have begun raising native species in addition to non-native fish. Rose Creek Hatchery near Bigfork and Yellowstone River Trout Hatchery near Big Timber now produce partially developed ("eyed") Arctic grayling eggs for planting in remote streamside incubators of the Big Hole and Ruby Rivers. Murray Springs Trout Hatchery near Eureka grows native redband trout for stocking in northwestern Montana streams.

PAUL QUENEAU

PROUD PAPA FWP fish culturist Toby Tabor shows westslope cutthroat fingerlings raised as wild source stock at the Sekokini Springs Hatchery near West Glacier. "The most satisfying part of my job is when all the fruits of our labor come to fruition," Tabor says. "You're putting out native wild westslope cutthroat trout for anglers of future generations to catch. It's good to be part of that."

The Miles City Fish Hatchery produces sauger and pallid sturgeon for eastern Montana native fish restoration projects. Plans are under way to study the feasibility of raising native burbot and western pearlshell mussels, Montana's only coldwater mussel and a state species of concern.

According to Eileen Ryce, supervisor of the FWP Hatchery Program, even hatcheries that don't produce native fish help in conservation efforts. Some have visitor centers and displays where schoolkids learn about native species. "And all hatcheries create angler opportunities that in turn generate license dollars that can be used for native fish conservation," Ryce says. "Another conservation value of our non-native hatcheries is that they create angler opportunities that lessen pressure on sensitive native populations."

FUTURE FISHERIES Fresh Yellowstone cutthroat eggs at Yellowstone River Trout Hatchery will hatch into trout for stocking in high mountain lakes in the Beartooths.

> "Our new focus is on quality rather than quantity."

MAKING HATCHERIES WILDER

Native fish don't like to be reared in hatcheries any more than bighorn sheep like to be raised in pens. "Hatcheries were originally designed for efficiency and ease of operation," says Ryce. "Now we're trying to adapt hatchery operations and rearing units to help 'wilder' fish survive better in the facilities." Hatchery crews do that by reducing stress on the fish, finding more natural diets, and moving young fish out from hatcheries as soon as possible. This work has challenged hatchery staff to think in new ways.

"Westslope cutthroat trout are by far the most difficult fish I've ever had to raise," says Mark Kornick, manager of FWP's Flathead Lake Salmon and Rose Creek Hatcheries. "They just don't tolerate hatchery situations like other species do." Kornick has spent his career working to see the world through the eyes of fish and developing new ways to keep hatchery fish as healthy and wild as possible. For example, he and other FWP hatchery managers have reduced the number of fish they put in each raceway and installed privacy covers to keep trout from panicking when a human looms overhead.

Today, state hatcheries that focus on native species raise a fraction of the fish they once produced. Having once cranked out tens of millions of trout every year, Washoe Park Trout Hatchery near Anaconda, Montana's oldest state hatchery, now provides a modest 1.5 million westslope cutthroat for stocking recreational sport fisheries and restoration projects. "You can't just throw food at westslope cutthroat and expect them to prosper," says Angela Smith, hatchery manager. "We're constantly reevaluating the way we spawn them, the way and what we feed them, how we handle them—every part of our whole program. These fish are a challenge."

One of Washoe Park's key responsibilities is managing a broodstock of pure westslope cutthroat trout using a mixture of genetics taken from 14 creeks in the Flathead and Clark Fork drainages. ("Broodstock" are adult fish that produce eggs for propagation. Some are kept in the hatchery, while others are spawned in the wild.) The strain has proved tough and adaptable, though it still requires more care to raise

Paul Queneau is a freelance writer and the conservation editor of Bugle *in Missoula.*

Protecting wild stocks from disease

Essential to protecting native fish populations is FWP's Fish Health Lab in Great Falls. Various viruses, bacterial kidney disease, and other maladies can weaken or even devastate wild populations. Before fish from a state hatchery can be stocked, fish health coordinator Ken Staigmiller tests a sample of fish and certifies the batch as disease-free. He also tests and certifies as disease-free wild spawner fish when eggs are collected for use in hatcheries. At least once a year, state, federal, and private hatcheries in Montana are inspected for fish pathogens.

Under Montana's strict disease regulations—meant to protect the state's renowned and valuable fisheries—when Staigmiller detects dangerous diseases or pathogens in a hatchery, the facility is immediately quarantined and the infected fish destroyed. The hatchery must be disinfected and then inspected and certified as disease-free before fish can again be stocked from the facility.

Fish health coordinator Ken Staigmiller takes tissue samples from ■ non-native carp.

The biggest risk in spreading disease comes from moving fish from one place to another, whether it's transporting hatchery rainbows to a kid's fishing pond or putting native westslope cutthroat into a conservation hatchery. "We do our best to reduce the risk of moving pathogens," says Staigmiller. "Whenever possible we need to test those fish to make sure we aren't putting native populations at risk." ■

TOP TO BOTTOM: CAROLYN BROWN; ERIC ROBERTS/MONTANA FWP

NATIVE NURSERIES Top: Sekokini Springs Hatchery manager Scott Relyea explains how he and his team work with FWP biologists to raise trout from eggs taken from streams containing purebred westslope cutthroat that are as geographically close as possible to the South Fork Flathead drainage lakes that FWP wants to stock. Above: At the Washoe Park Trout Hatchery, hatchery manager Angela Smith and fish culture specialist Taylor Lipscomb show how simple tank covers help protect westslope cutthroat trout from excess stress, increasing the odds that the fish will survive in the wild. Right: Fish culturist Toby Tabor and Scott Relyea ready westslope cutthroat trout for stocking.

ALL PHOTOS BY PAUL QUENEAU

than domestic rainbow trout.

Kornick says that when he began raising fish, a hatchery's value was based on how many it could produce at the lowest possible cost. "Now we're measured by how many high-quality fish we produce to meet both management and conservation objectives." In the long run, that approach not only helps native populations but also saves money. "Let's say you stock 100,000 weakling trout and maybe 1,000 survive, but if you put out 50,000 healthy native fish that are genetically adapted to that environment, maybe 10,000 will survive," Kornick says. "So it costs you a little more per fish to raise those 50,000 natives, but you're getting a lot bigger return for your buck."

According to Ryce, FWP hatcheries are shifting emphasis from how well fish perform in the hatchery to how well they survive in the wild. "Our new focus is on quality rather than quantity," she says.

A LEGAL FISH INTRODUCTION Larry Timchak, president of Flathead Valley Trout Unlimited, helps FWP biologists release native westslope cutthroat trout into Smith Lake near Whitefish in early November 2015. The trout were raised at the Sekokini Springs Hatchery near West Glacier. Trout Unlimited works closely with FWP on native trout hatchery projects across western Montana.

RESTORING THE SOUTH FORK

Robb Leary recalls the raised eyebrows he got from fellow fisheries biologists 35 years ago when he told them he was taking courses in genetics. "Genetics wasn't a part of fisheries management back then—definitely not in hatcheries or even in wild or native fish conservation," Leary says. His title is now FWP fish conservation geneticist, and his specialty has become a linchpin of native fish management.

Leary helped discover the DNA variation among westslope populations in separate drainages (remember the Chihuahua and Labrador retriever analogy?). That revelation underscored how important it was that FWP's conservation work didn't inadvertently dilute, replace, or otherwise damage native gene pools.

> "Now we're measured by how many high-quality fish we produce to meet management and conservation objectives."

One of Montana's most important bastions for westslope cutthroat trout is the South Fork of the Flathead. Cordoned off since 1953 by Hungry Horse Dam, the river gives rise to what may be the best watershed left in the Lower 48 to protect a large, diverse network of pure westslope cutthroat trout streams. It currently hosts half of Montana's range for genetically pure and interconnected populations of the species.

Unfortunately, 21 of the high mountain lakes in the watershed were long ago planted with rainbows and Yellowstone cutthroat to provide fishing opportunities. For nearly a decade FWP crews have worked to replace those non-natives with pure-strain westslope cutthroat. The goal: to preserve the South Fork Flathead drainage as a stronghold for Montana's state fish.

The native trout are produced at Sekokini Springs Hatchery near West Glacier. Rather than use the generalist broodstock raised at Washoe Park, hatchery manager Scott Relyea and his team are working with biologists to raise trout from eggs taken from "nearest neighbor" streams. These waters contain purebred westslope cutthroat and are as geographically close as possible to the South Fork Flathead drainage lakes that FWP wants to stock. "The theory is that these trout will be better adapted to the local environment," Relyea says.

To make sure the cutthroat trout fry don't become accustomed to hatchery life, they are whisked away to the release lakes, typically by helicopter, just two months or less from the time they hatch. "We work really hard to minimize human contact and human interaction with the fish here," Relyea says. "We cover the tanks, create shaded areas, and provide a variety of flow speeds. The idea is to create conditions as similar to a real stream as we can while still being able to keep the tanks clean."

Relyea's team has recently begun a pilot study to raise a type of zooplankton that

PAUL QUENEAU

could be a natural food for the westslope cutthroat fry while in the hatchery before the tiny fish are stocked. Currently the trout are fed commercial meal that doesn't resemble wild foods. "The idea is that when we stock them into the lake, they'll have seen zooplankton before and will know it's good to eat," Relyea says.

PREVENTING EXTINCTION

Five hundred miles southwest of Sekokini Springs, an FWP hatchery is leading an urgent effort to save one of North America's largest and rarest freshwater fish—the pallid sturgeon. The prehistoric species, which existed when T. rex roamed the region, can live 50 or more years, grow six feet long, and weigh more than 75 pounds.

Listed as endangered in 1990, Montana's estimated 150 or so remaining pallid sturgeon are confined to the lower Missouri River above and below Fort Peck Reservoir, and the lower Yellowstone River below Intake Dam downstream from Glendive. The fish can't successfully reproduce mainly because dams block upstream movement to historic spawning waters. Each year biologists capture a few remaining wild adult pallid sturgeon, transport them to FWP's Miles City Fish Hatchery and a federal hatchery in North Dakota to be stripped of eggs and milt before being returned to the wild. The sturgeon eggs are incubated and the young fish reared according to stringent propagation and genetics management guidelines that a multidisciplinary group representing state, federal, university, and tribal interests developed.

When the young fish reach three to seven inches long, biologists mark them with tags before release into the Missouri and Yellowstone Rivers. The young hatchery-reared sturgeon are surviving, but they likely won't have any better success reproducing naturally than their parents did. FWP officials have for years worked to find ways for spawning sturgeon to bypass Intake Dam and have urged the U.S. Army Corps of Engineers to adjust water flows below Fort Peck Dam to mimic natural water regimes that create better sturgeon habitat. Until those changes take place, the Miles City hatchery remains the pallid sturgeon's last hope in Montana.

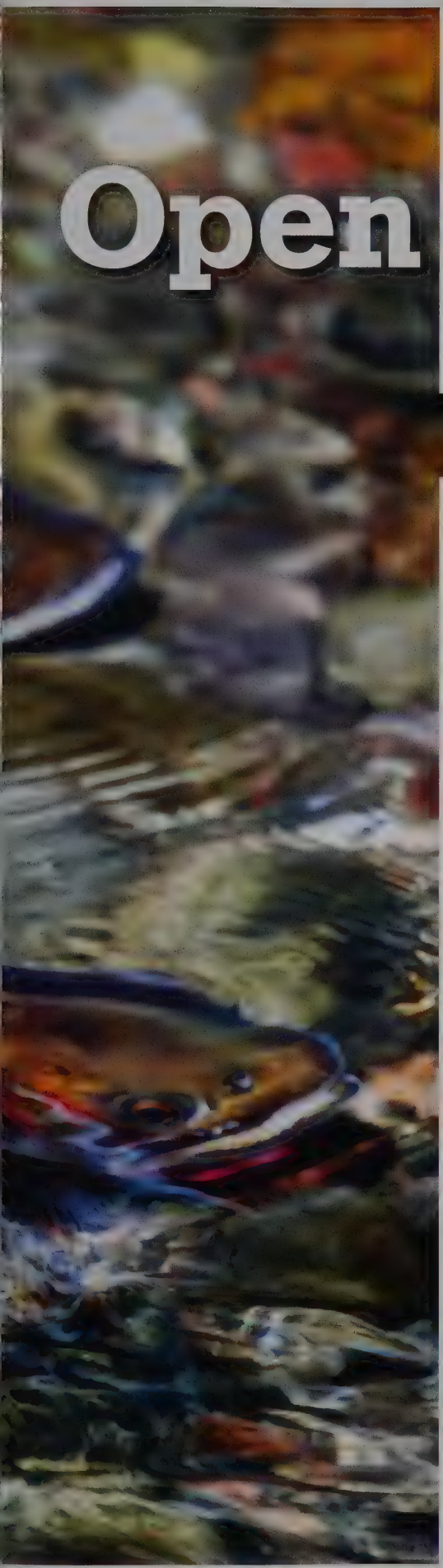
Who'd have thought that the salvation of this ancient fish—not to mention wild cutthroat and other native species in watersheds across Montana—could come from facilities best known for their role in stocking large reservoirs and helping anglers fill their livewells with fat rainbow trout and walleyes?

Like I said, looks can be deceiving.

HANGING ON Above: One of Montana's roughly 150 remaining adult pallid sturgeon, an endangered species, is captured for transport to the Miles City Fish Hatchery to be stripped of eggs before release back to the wild. The eggs are incubated (above right) according to strict guidelines. Below: Once they reach three to seven inches long, the juvenile pallids are released into the Yellowstone and Missouri Rivers, where they currently are surviving but are unable to reproduce because dams block upstream passage.

ALL PHOTOS THIS PAGE: MONTANA FWP

ON TO SPAWN Spawning Yellowstone cutthroat trout swim up a tributary of the Yellowstone River. When historical migrations like these are blocked, fish populations suffer.



CINDY GOEDDEL

Open or Close?

Why connectivity is essential for native fish populations—except when it isn't.

By Tom Dickson

When you catch a trout, sauger, or other species from a river or stream, it's natural to assume the fish spent most, if not all, of its life in that one spot.

Yet that fish probably didn't stay put. It likely moved upstream and downstream many times throughout the year, perhaps traveling 100 miles or more. "There's a whole world of fish movement down there, like an underwater freeway that people don't see," says Emma Cayer, Montana Fish, Wildlife & Parks Arctic grayling habitat biologist in Dillon.

Because fish often must travel great distances to complete their annual life cycle, barriers to movement threaten their existence. That's why fisheries biologists spend a great deal of time identifying things that thwart movement, such as dams or degraded stream habitat, and working to help fish swim past those barriers.

But a century of human landscape alterations and new fish introductions have made fish connectivity a complicated matter. As unlikely as it might sound, occasionally a barrier that blocks fish migration is the only thing keeping a population from disappearing altogether.

On the go

Whether it's a redband trout in northwestern Montana or a blue sucker in the lower Yellowstone River, each fish has a wide range of habitat needs during its lifetime and throughout the year.

For instance, river-dwelling westslope cutthroat trout need to lay their eggs in the clean gravel of shallow, clear water found in high mountain streams. Each spring cutthroat make their way up from mainstem rivers, like salmon moving up from the Pacific Ocean, in search of ideal spawning habitat. After spawning, the fish move back downstream to slow-current mainstem pools, where they rest and recover from the stress of spawning. If river water becomes too warm in midsummer, trout move once again, seeking cooler stretches fed by underground springs or mountain streams. In fall, when fish need to bulk up for winter, the trout move to shallower stretches where they can find food more easily. When cold weather arrives and their metabolism slows, the trout hunker down in deep pools to conserve energy in the slow current.

To reach seasonal habitats, fish need the ability to travel. Distances vary widely. Some minnow species like dace, shiners, and chubs that live in small streams can meet their seasonal habitat needs in a stretch no longer than a football field. Larger big-river fish like channel catfish, bull trout, and shovelnose sturgeon might need to swim many miles during the year to find the right conditions. "Over time, most fish

have adapted to use as much habitat in the watershed as they need," says David Schmetterling, coordinator of the FWP Fisheries Research Program in Missoula. "By migrating, a species is hedging its bets, so to speak, so that if something goes wrong in one portion, the population still survives because it's using others."

UNIVERSAL NECESSITY High-profile species such as trout and sauger aren't the only ones that must migrate to complete their annual life cycle. Minnows like the redside shiner (above) and prehistoric relics like the shovelnose sturgeon (right) also require water free of barriers.

Tracking fish movement

For years, fisheries biologists had little idea how far fish traveled. The heroic migrations of Pacific salmon were widely known. But who knew that burbot, channel catfish, and cutthroat trout swimming in inland waters also needed to migrate?

> "Some sauger that we captured would swim 150 miles downstream, spawn, then move 150 miles back upstream."

During the past 20 years, new technology has allowed scientists to track the movement of these and other species. Fisheries biologists can now surgically implant tiny radio transmitters the size of an AA battery into the belly of fish (an amazing 85 to 100 percent of which typically survive the procedure, depending on the species). Biologists then follow the fish by using handheld receivers or periodically monitoring stations set up 20 to 30 miles apart along a river that record when tagged fish pass.

In recent years, biologists have learned that resident trout (those that stay in tributaries their whole lives) might move just a few hundred yards during the year, while migratory trout (which spawn in tributaries but live most of their lives in the mainstem river or connected lakes) can cover over 100 miles. Some highly migratory Arctic grayling travel 60 to 80 miles. One FWP study found that almost all of the sauger in the Missouri upstream from Fort Peck Reservoir spawn in a single reach near the Fred Robinson Bridge. "Some that we captured and radiotagged as far away as below Great Falls would swim 150 miles downstream, spawn, then move 150 miles back upstream," says Anne Tews, FWP fisheries biologist in Lewistown.

The farthest-ranging specimen that FWP biologists have tracked so far is a paddlefish originally tagged in the Wolf Point area of the Missouri River. In a single year, the nomadic fish traveled at least 670 river miles: up and down the Milk River, down the Missouri to North Dakota, and finally back to where biologists first captured it.

Stopping the flow

"That tells you just how far some of these big-river species need to migrate," says Steve Dalbey, FWP fisheries manager in Glasgow. He points out that, historically, fish evolved with intact stream and river systems that had full connectivity. An occasional mudslide, avalanche, or drought impeded fish movement, but for the most part fish could swim where they needed to go. Then people started to develop the land, altering streams and rivers.

For instance, for the 100 years before it was removed in 2008, Milltown Dam at the confluence of the Blackfoot and Clark Fork Rivers east of Missoula blocked upstream migration. One FWP study found that 200,000 fish of 11 different species stacked up below the structure each year. "Those fish didn't just turn around and find somewhere else to spawn," says Schmetterling. "They would stay at the dam and try to move past it for days or even months."

In addition to blocking movement with their presence, large dams like the one below

Tom Dickson is editor of Montana Outdoors.

FISH FOLLOWERS Left: FWP biologists surgically implant transmitters in rainbow trout to track fish migration up the Clark Fork after removal of Milltown Dam in 2008. Right: Biologists tag paddlefish with colored, numbered bands—later reported by recreational snaggers—as well as with radio transmitters. One Missouri River paddlefish traveled nearly 700 miles in one year.

CLOCKWISE FROM TOP LEFT: TODD PEARSONS/ENGBRETSON UNDERWATER PHOTOGRAPHY; MONTANA FWP; MONTANA FWP; LARRY DEARS, LARRY DEARS

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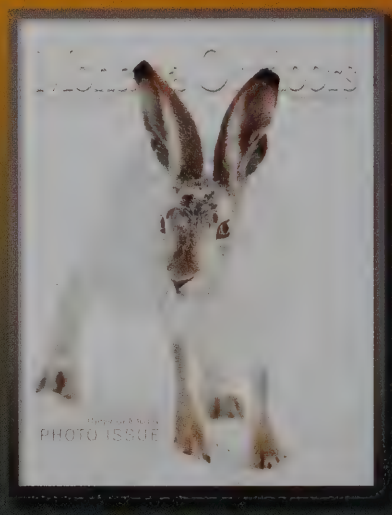

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BLOCKED OUT? Trout usually can make their way through natural barriers like beaver dams (left). But large impoundments such as Diversion Dam (above) on the Sun River create impassable barriers that block fish from reaching seasonal habitats.

Fort Peck Reservoir can create movement barriers by turning the river upstream into a lake and changing historic downstream flow patterns and water temperatures. "Big dams can completely disrupt how a river functions," says Tews.

Hundreds of diversion dams on streams and rivers across Montana that redirect water into irrigation canals for watering crops also block upstream fish movement. Thousands of "perched" culverts running under mountain forest roads create miniature waterfalls that many species can't ascend. In some cases, stock dams in eastern Montana disrupt the movement of plains killifish, Iowa darters, brook sticklebacks, and other little-known prairie species.

In addition to these physical barriers, habitat barriers make some stream stretches impassable. Low flows, muddy water, and chemicals leaching from acid mine drainage can block fish movement as effectively as any concrete dam. So can wide, shallow areas of warm water created when cattle trample stream banks. "In the heat of summer, if a sensitive fish like a grayling can't get past that habitat barrier and instead gets stranded in pools that have low water and little oxygen, it will die," says Cayer.

Velocity barriers are those in which water speed is far too fast for fish to move past. "When you have a six-foot-wide stream flowing into a two-foot-wide culvert, the water during spring runoff shoots out the other side like a fire hose," says Ladd Knotek, FWP fisheries biologist in Missoula. "Even strong swimmers like bull trout can't get through undersized pipes at high flows."

Barrier problems

So *what* if bull trout can't get through a culvert? Can't they simply turn around and spawn elsewhere?

Probably not. "Bull trout will return to the stream where they were born and make every effort to spawn there," says Schmetterling. "They rarely just peel off and go to another stream to spawn, like rainbows and browns. They've evolved in a way that 'site fidelity' is critical to their survival."

One problem with barriers is they prevent fish from reaching the very best seasonal habitats they need to survive. For instance, newly hatched pallid sturgeon larvae must drift downstream for hundreds of miles in a river to develop sufficiently for survival. But because spawning pallids can't get upstream from Fort Peck Dam on the Missouri or Intake Dam on the Yellowstone, their larvae float into North Dakota's Lake Sakakawea, an impoundment of the Missouri created with completion of Garrison Dam in 1954. There the underdeveloped fish sink into an oxygen-deprived "dead zone" and suffocate.

DRINK HERE, PLEASE To prevent bank trampling that makes water too shallow and warm for trout migrations, cattle are confined to watering areas as part of a Montana State University study near Belgrade.

Barriers also isolate fish populations, making them more susceptible, in the long term, to catastrophic events such as a forest fire that boils all the fish in a stretch of mountain stream. "Without full connectivity, that tributary could never be recolonized with fish coming up from the mainstem," says Knotek. Isolation also limits genetic exchange, leading to inbreeding and the loss of genetic variability.

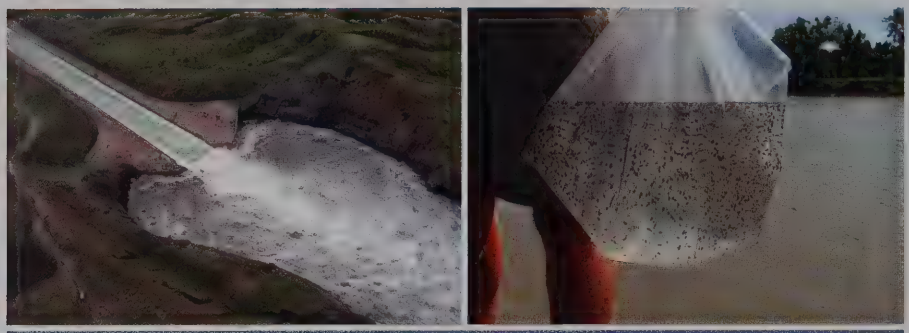
Restoring movement

Restoring fish connectivity can be as easy as removing an obsolete diversion dam. And as hard as convincing federal agencies to alter their operations.

Installed in 2007, the Muggli Fish Passage in southeastern Montana allows channel catfish, sauger, and other prairie fish passage up an additional 50 miles of the Tongue River blocked since the late 1800s. In the Upper Big Hole watershed, Cayer and others have helped grayling swim past 42 diversion dams by installing small fish ladders that open up 60 miles of habitat on the mainstem Big Hole and tributaries.

Bull trout can now bypass Thompson Falls Dam on the lower Clark Fork thanks to

CLOCKWISE FROM TOP LEFT: ALLEN WIEDERRICH; CRAIG & LIZ LARCOM; ADAM SIGLER



RUINING REPRODUCTION Fort Peck Dam (spillway, top left) blocks pallid sturgeon migration and disrupts natural flow regimes. As a result, FWP must raise sturgeon larvae (above right) in its Miles City Fish Hatchery for release into the Missouri and Yellowstone Rivers.

a $10 million fish ladder. Farther downstream, biologists with Avista Corporation transport bull trout by truck around Cabinet Gorge Dam to upstream tributaries during spawning season as part of an agreement between the company and state and federal fisheries management agencies.

On several tributaries of the Blackfoot River, westslope cutthroat are returning to reaches blocked for decades by low water in midsummer. When landowners changed their irrigation regimes, minimum stream flows were restored so fish could pass.

In national forests throughout western Montana, FWP biologists are working with U.S. Forest Service crews and Trout Unlimited volunteers to replace small culverts with larger ones built with a rough rather than smooth bottom. "If you're a fish moving upstream, you shouldn't even notice the difference between that and the natural stream," says Knotek.

Unfortunately, helping pallid sturgeon is not so simple. At Fort Peck Dam, all biologists can do is continue to urge the U.S. Army Corps of Engineers to adjust water releases below the dam at key times to mimic natural flows. "We are recommending a brief pulse in spring to trigger adult pallid spawning movement closer to the dam, and then lower flows later in early summer to slow larval drift," says Dalbey. At Intake Dam on the Yellowstone, the Corps of Engineers is working on an Environmental Impact Statement that evaluates fish passage options.

Beneficial barriers?

Despite the harm they do to fish populations, sometimes migration barriers such as culverts, degraded habitat, and even dams can benefit fish populations. Barriers slow the spread of viruses and other fish diseases. They keep invasive species such as carp and northern pike from degrading existing fisheries. Barriers also prevent rainbow trout from moving upstream and mixing with pure-strain westslope cutthroat, and they stop aggressive non-native brook trout and brown trout from crowding out native species.

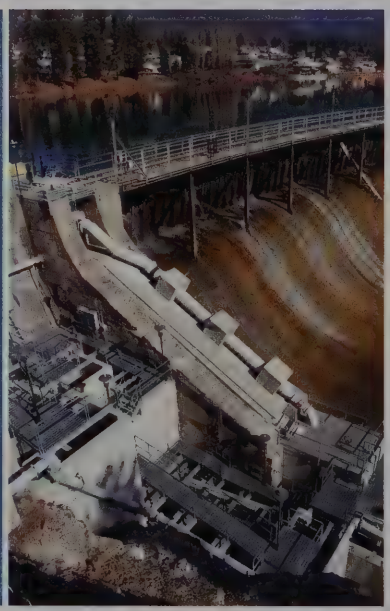
Take Hungry Horse Dam, for example. Since it was built in 1953 to impound the lower South Fork of the Flathead River, the structure has protected bull trout, westslope cutthroat, sculpins, and other native species in the nearly 9,000-square-mile watershed from incursions by non-native fish. "Before widespread human settlement, a barrier would have only caused problems for fish populations," says Don Skaar, a senior FWP fisheries official. "But with the spread of fish disease and growing threats from introduced fish, the issue is more complicated."

Hybridization by and competition from non-native trout is the biggest threat facing westslope cutthroat east of the Continental Divide, where the native species occupies a small fraction of its historic range. FWP rates the risk of westslope cutthroat extinction for many local populations as "high to extreme." To protect high mountain populations from threats by non-native trout downstream, the agency occasionally builds fish barriers and has reintroduced westslope cutthroat above natural waterfalls.

The problem, of course, is that the same

> "By migrating, a species is hedging its bets, so to speak, so that if something goes wrong in one portion of a stream, the population survives because it's still able to use other portions."

CLIMB, FISH, CLIMB Left: In 2015, a small fish ladder was installed to help spawning brown trout from Ennis Lake migrate into Smith Lake. Anglers reported seeing brown trout upstream of the ladder just a few months after installation. Right: Built in 2009, the $10 million Thompson Falls fish ladder is the first full-height fish passage in the United States constructed specifically for bull trout. After 95 years, the fish once again migrate upriver past Thompson Falls Dam into hundreds of miles of native spawning waters in the upper Clark Fork drainage.

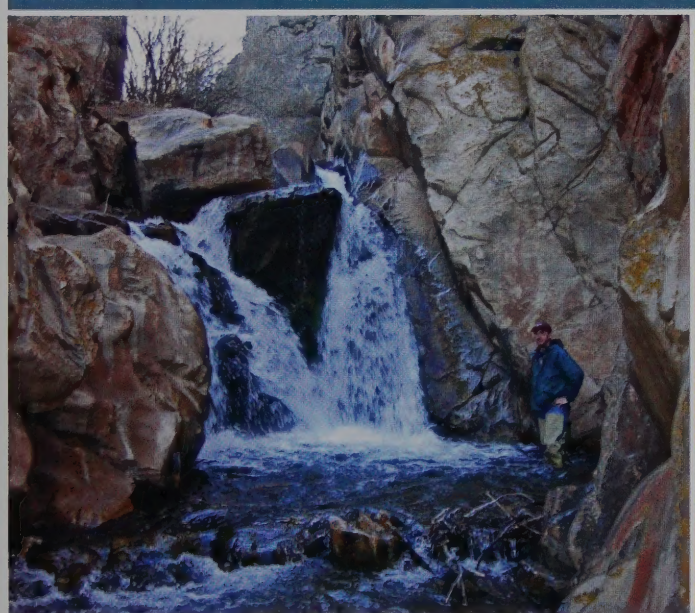


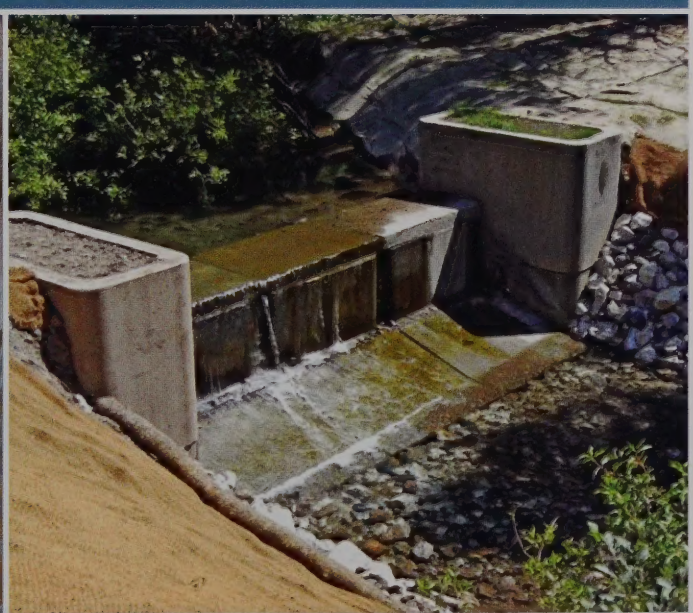
CLOCKWISE FROM TOP LEFT: MONTANA FWP; U.S. ARMY CORPS OF ENGINEERS; DEBRA KRANTZ; JOSHUA BERGAN

structures blocking rainbow trout from headwaters prevent the "protected" cutthroat trout up there from fully using the stream systems. By isolating small cutthroat populations, barriers make them vulnerable to inbreeding and catastrophic floods, drought, or wildfire. "Any time we consider building a barrier, we have to weigh the pros and cons," says Dave Moser, FWP fisheries biologist in Bozeman. "Installing a barrier is only a last resort for extremely low populations where the danger of extirpation [local extinction] from hybridization or competition outweighs the loss of connectivity."

According to Bruce Rich, head of the FWP Fisheries Division, biologists make that same analysis before removing or helping fish bypass a barrier anywhere in Montana. "Whenever we consider restoring connectivity, we have to consider all the possible consequences, like unwanted fish moving upstream or the high cost of building and maintaining a barrier," he says. "Sometimes, even with potential benefits, it's just not worth doing. There's no one-size-fits-all approach to connectivity. All we can do is go case by case and figure out what each fish population needs most and how we can best meet those needs.

"For some fish populations," adds Rich, "the only thing worse than a barrier might be no barrier at all."





REMOVING SOME BARRIERS WHILE CREATING OTHERS Top left: A typical "perched" culvert on a tributary of the Blackfoot River blocked upstream bull trout and westslope cutthroat trout migration by creating a waterfall during low water and a high-velocity torrent during spring runoff. As in many forested watersheds across western Montana, the culvert was replaced by a free-span bridge (above right) that allows for natural fish movement. Below left: A natural waterfall on Ruby Creek near Ennis protects a reintroduced westslope cutthroat trout population upstream from hybridization by non-native rainbow trout below. Below right: FWP built this concrete box culvert on White Creek, a tributary to Canyon Ferry Reservoir, to safeguard pure-strain westslope cutthroat trout above the structure from non-native fish downstream.

ALL PHOTOS THIS PAGE: MONTANA FWP

The Perils of a Young Trout

by Bruce Auchly

The spring spawning run of rainbow trout is over. From the Kootenai to the Bighorn, spawners have moved down from the tributaries, where they laid their eggs, to the rivers' mainstem, where they will spend the next 10 months until the reproductive urge strikes again.

Meanwhile, up in those tributaries, the perils of newly hatched trout are just beginning.

And that's assuming the eggs themselves survive. Some years, melting snow and rain produce tremendous runoff in the tributaries of major rivers. Torrents of rushing water destroy redds (spawning nests made in gravel) and wash eggs away.

Using water temperatures as a guide, fisheries biologists can predict when female trout will spawn and eggs will hatch. Rainbows and cutthroat are spring spawners. On Missouri River tributaries, for example, eggs deposited on March 30 will usually hatch around May 9, while eggs laid April 15 will hatch about May 18. Eggs of brown trout, which spawn in the fall, generally hatch in January or February, giving those young fish a head start on baby rainbows and cutthroat.

In years of late runoff, young fish hatched earlier in the spring (or even winter, like brown trout) have a better chance of surviving heavy flows than eggs not yet hatched. A baby trout can escape swift current by swimming to a side channel; an egg can't.

Drought is simple. Low, warm water, no fish. No fish, no eggs.

About 1 percent of rainbow eggs survive all that to become a one-year-old fish. Fisheries biologists refer to those fish as "recruited" into the population.

So how does an egg become a trout?

Once an egg hatches, the newborn trout is called an alevin. It lives in the stream gravel, feeding for three to five weeks off the remaining yolk attached to its body.

After it has absorbed its egg sac, the tiny trout is known as a fry and now must find a new food source. This vulnerable period is when most young trout die. The one-inch fish are too slow to escape predators—mainly larger trout—and have a tough time consuming enough microscopic crustaceans (zooplankton) to survive.

For the next one to three years, the young trout stays in the tributary, growing bigger in preparation for eventually "outmigrating" downstream to the mainstem river. ("Resident" trout stay in the stream their entire lives.) During this period, the juvenile trout begins to feed on mayfly larvae and caddis fly pupae, as well as scuds and tiny fish.

What perils further await this young fish? Let me count the ways.

Floods can dash young trout against rocks. Even worse are droughts. When flows are depleted, young fish are forced into the same waters as adult fish. And, as we all know, it's a fish-eat-fish world out there.

When fish are concentrated, it's also easier for other predators, whether kingfishers from above or otters from below, to find a meal.

If a trout escapes all that, it will reach about four to eight inches long by its first birthday. By age two, it's about seven to twelve inches long. Now the fish has to start contending with human angling.

While many anglers practice catch-and-release, a certain percentage of fish die after they are let go. Like when a fish is caught and kept out of the water too long for photographs, or is allowed to fight too long on a hot day when the water is warm. Some anglers occasionally keep a fish or two for the frying pan. That's allowed under most FWP fishing regulations, because it has no discernible effect on the overall population.

On an individual trout, of course, it's a different story. But then again, no one ever said it was easy being a fish.

ILLUSTRATION BY E.R. JENNE

Bruce Auchly manages the FWP Regional Information and Education Program in Great Falls.

Trillium

Trillium ovatum

By Ellen Horowitz

JOHN R. SHARKEY

Scientific name

Trillium is Latin for "triple," referring to the plant's three leaves and three petals. ***Ovatum*** is Latin for "oval" or "egg-shaped," a reference to the shape of the leaves.

In the moist forested foothills and valleys of western Montana, spring is announced each year by the elegant white blossoms of trillium. These understated beauties begin to bloom in late April at low elevations. Their flowering progresses through June as spring conditions slowly climb the mountains.

Like most native wildflowers of the West, trillium are perennials. What sets them apart is their longevity. One plant in Oregon grew to be 72 years old.

The lives of these simple-looking flowers are surprisingly complex.

Identification

Of the roughly 40 species of trillium that exist in North America, Montana is home to just one, *Trillium ovatum*. Easy to recognize, this plant consists of a single flower with three white (usually) petals perched atop a stem supporting a whorl of three green leaves. It's not uncommon to find a trillium with purplish-pink or rose-colored petals. Some biologists believe the color change alerts insects that the flower is past the pollination stage, that it's "closed for business."

Life history

If you're lucky enough to encounter a patch of trillium on a walk in the woods, you may notice considerable differences in plant size. A trillium's height, as well as the shape and dimension of the leaves, reveals the plant's relative age (whether young, middle aged, or mature). Mature trillium stand more than a foot tall. Their leaves measure up to five inches long, and flowers reach one and one-half inches in diameter.

For the past 14 years, Tarn Ream of Missoula has studied the complex lives of these forest-dwelling plants. She says that *Trillium ovatum* grow only from seeds, which take two years to germinate. For the first few years, the immature plant bears just one leaf. Eventually it reaches the status of a three-leaf juvenile. Ream's research shows that a trillium in Montana takes at least 18 years to produce its first flower. In addition, each year more than one-quarter of mature plants in a given area take a break from blooming and do not produce a flower. The reason remains a mystery.

Common names

Among the common names for Montana's species of trillium are western trillium and Pacific trillium. In some parts of the country, trillium are known as wake-robin because they bloom roughly when robins return in spring. Trillium are also called bethroot or birthroot for the traditional Native American use of the plant's root, an infusion used to promote menstruation. Many botanists continue to place trillium in the Liliaceae family, yet others classify it as a member of a new family, Trilliaceae.

Pollination and dispersal

Trillium rely on beetles and bees for pollination. An insect feasting on the pollen is dusted with fine, powdery grains. The insect inadvertently transfers this pollen to the stigma of the next trillium flower it visits, cross-pollinating that plant.

Ants help disperse and germinate trillium seeds. On the outside of each brown seed is a bright yellow cap-like extension called an elaiosome. Ants bite into this delectable, fleshy covering and haul the seed back to their nest. After dining on the fatty, protein-rich elaiosome, the insects discard the intact seed into their refuse pile, where it eventually germinates. Ream says trillium seeds are dispersed even farther by white-tailed and mule deer feeding on the seed-containing fruit.

Research also indicates that deer can cause trillium populations to decline if they overbrowse the vegetation. The slow-growing plants are extremely sensitive to habitat loss, indiscriminate picking, and overharvesting for medicinal or garden use.

Considering the plant's remarkable longevity and late age of first flowering, it's hard not to think of trillium in terms of human life spans. The sight of one always causes me to stop and reflect on the majestic woodland elder with the respect it is due.

Writer Ellen Horowitz lives in Columbia Falls.

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PARTING SHOT

FISH-FRIENDLY FACILITY Arctic grayling and large trout swim in a pool outside the visitor center at Montana's oldest state trout hatchery, Washoe Park, built in 1907. See how this and other hatcheries are helping restore westslope cutthroat trout and other native fish species on page 28. Photo by Paul Queneau.

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